EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY

THESIS

FOR THE AWARD OF A DEGREE OF

MASTERS OF SURGERY

SESSION 2020-2023

DR.SAMRIDHI MISHRA

SANTOSH DEEMED TO BE UNIVERSITY
NO. 1, SANTOSH NAGAR,
GHAZIABAD-201009, NCR DELHI, INDIA

DEPARTMENT OF ENT
SANTOSH MEDICAL COLLEGE & HOSPITAL
GHAZIABAD, NCR DELHI

COPYRIGHT CERTIFICATE DECLARATION BY THE CANDIDATE

I hereby declare that Santosh Deemed to be University, Ghaziabad, (U.P.) shall have the right to preserve, use and disseminate this thesis titled

"EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY"

in print or electronic format, for academic or research purpose.

Signature of Candidate:

Date:

Place:

CERTIFICATE BY THE GUIDE

This is to certify that the thesis titled

"EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY"

is abonafide genuine research work carried out by **Dr. SAMRIDHI MISHRA** in partial fulfillment of the requirements for the award of the degree of M.S. in the specialty of ENT .under my guidance and supervision and is completed to my full satisfaction.

Guide

Dr**.** SUSHIL GAUR

PROFESSOR

Department of ENT
Santosh Medical College & Hospital
Ghaziabad (U.P.), India

CERTIFICATE BY THE CO-GUIDE

This is to certify that the thesis

"EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY"

is abonafide genuine research work carried out by **Dr. SAMRIDHI MISHRA in** partial fulfillment of the requirements for the award of the degree of M.S. in the specialty of ENT.

Co-Guide

Dr(Prof). Tarun Malhotra
HOD
Department of ENT
Santosh Medical College & Hospital
Ghaziabad (UP), India

CERTIFICATE BY THE HEAD OF THE DEPARTMENT

This is to certify that the thesis titled

"EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY"

is abonafide research work carried out by **Dr. SAMRIDHI MISHRA** in partial fulfillment of the requirements for the award of the degree of M.S. ENT will be based on bonafide work carried out by him /her.

PROF. (Dr.) Tarun Malhotra M.B.B.S., M.S.
Professor & Head
Department of ENT
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P.)

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

ENDORSEMENT BY THE DEAN OF THE COLLEGE

This is to certify that the thesis titled

"EVALUATION OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID CELL PNEUMATISATION ON MYRINGOPLASTY"

is a bonafide research work carried out by **Dr. SAMRIDHI MISHRA** under the esteemed guidance of **Dr. SUSHIL GAUR** Santosh Medical college and is presented before the ethical committee of Santosh University, Ghaziabad for requisite approval.

Dr. Alka Agarwal

Dean
Faculty of Medical Sciences
Santosh Medical College & Hospital
Santosh Deemed to be University
Ghaziabad – 201001 (U.P.)

ACKNOWLEDGEMENT

It gives me great pleasure to express my sincere gratitude to Dr Sushil Gaur who has been the guiding force and inspiration for the study. He was the strength behind the project from its conception to its culmination guiding me at each obstacle. His principle , integrity and sincerity shall always guide me in my life and career.

I am extremely thankful to my Co-guide Dr Tarun Malhotra (Professor and head of Dept, Dept of E.N.T.,SMC&H) for his invaluable help at every stage of this study. I take this opportunity to thank him for his esteemed guidance, patience and teachings.

I would also like to thank Dr. Vandana Singh,Dr Abhay Kr Singh without whom this study would not have been possible. Their invaluable help and blessings made my job simpler.

I would also like to thank Dr. Raina Rathore(AP),Dr Abhinav Raj(AP),Department of E.N.T.,SMC&H.) for there kindness and co-operation at every step of this study.

I would also like to acknowledge the help of my various colleagues, seniors and juniors. A special word of thanks for Dr.Shruti Tandon for critical inroads into the subject and their invaluable contribution to the work. I would also like to thank my co-graduates Dr. Ravi Gupta, Dr. Mansi Sharma and Dr. Dirgh Shah in their endeavor both for the selection of cases and their follow-up.

I would also like to thank my dear friend Dr Gaurav Gupta for being a constant support system in my journey and, my juniors Dr Tania Maity, Dr Sindhura KP, Dr Kritika Prasad & Dr Anjani Yadav for their constant support and encouragement.

And at last i would also like to thank my parentsMr Digvijay Mishra and Mrs Rajni Mishra , my sister & my dearest brother in law Mrs Utkarsha Mishra and Mr Kshitij Singh for all the support.

I also thank our departmental staff Mr. Mahipat Singh Rawat and Mr. Rajhans Sharan whose experience have lent a helping hand in completing any work assigned to me in the department inspiration and love.

INDEX

1) **INTRODUCTION**

2) **AIMS AND OBJECTIVES**

3) **REVIEW OF LITERATURE**

4) **METHODOLOGY**

5) **RESULT**

6) **DISCUSSION**

7) **SUMMARY**

8) **CONCLUSION**

9) **REFERENCES**

10) **ANNEXURE**

    a. **PROFORMA**

    b. **CONSENT**

    c. **MASTERCHART**

INTRODUCTION

INTRODUCTION

Myringoplasty is among the most commonly performed surgical procedures by ENT surgeons worldwide, involving the reconstruction of tympanic membrane perforations, with an appropriate graft material, such as autograft, allograft, or synthetic materials.

There has been continuous advancement in the approach and technique of performing the procedure, but the incidence of unfavorable outcomes has still been significant.

The functional status of the Eustachian tube and mastoid cell pneumatization is among the most significant prognostic factors of myringoplasty.

Studies based on the prognostic value of Eustachian tube function on the outcome of myringoplasty have not been conclusive due to contradictory inferences.

Not much literal evidence is available on the postoperative hearing status of the patient, as an assessment criterion.

This study involves the evaluation of the combined effect of eustachian tube function and mastoid cell pneumatization on the results of myringoplasty in terms of graft uptake and hearing improvement, the study also involves the assessment of co-relation between Eustachian tube function and mastoid air cells pneumatization.

The study is being formulated on the principles of interventional study, which involves case selection based on pre-determined criteria, pre-op evaluation of the cases, surgical procedures, and follow-up.

AIMS AND OBJECTIVES

TO STUDY THE INFLUENCE OF EUSTACHIAN TUBE FUNCTIONAL STATUS AND MASTOID PNEUMATISATION ON GRAFT TAKE UP & HEARING STATUS AFTER MYRINGOPLASTY

ANATOMY

The tympanic membrane is an oval structure present between the EAC and the tympanic cavity, it lies obliquely at the end of the EAC. It is convex towards the middle ear cavity and the umbo is known as the point of maximum convexity. The dimensions of the tympanic membrane are the following in adults;

Length-10 mm approx

Width-9 mm approx

Thickness-around 0.1-0.2 approx

It consists of three layers

1) Outer epithelial layer. (continuous with epithelial of EAC)
2) Middle fibrous layer. (present only in pars tensa)
3) Inner mucosal layer.

The handle of the malleus has adhered to a fibrous layer with its short process projecting laterally. The annulus is the fibro-cartilaginous ring that fits into the tympanic sulcus of temporal bone; it is anincomplete ring that is deficient above forming the notch of rivinus, which is occupied by the pars flaccida.

VASCULAR SUPPLY

- External supply by Arteria Manubri, which is a branch of the deep auricular branch of the maxillary artery.
- Internal supply by;
  a) Peripheral vascular circle including.
     - Anterior tympanic artery.
     - Posterior tympanic artery.
     - Tubal twing from ascending pharyngeal anastomosis.
  b) Arteria nutrica malleonicudi.

NERVE SUPPLY

1) Internal

   The glossopharyngeal nerve is formed by the tympanic plexus.
2) External
   a) Auriculotemporal branch of trigeminal nerve.
   b) Auricular branch of the vagus nerve.

MIDDLE EAR

The middle ear cleft is an air-filled space also known as the tympanum. It extends into the adjacent region of the temporal bone and mastoid air cell system and also has a connection with the pharynx through the Eustachian tube.

BOUNDARIES

1) **The lateral wall** –is formed by the tympanic membrane and a part of it is formed by squamous temporal bone which is present above the tympanic membrane in the attic region.
2) **Roof**- formed by tegmen tympani, which separates the middle ear cavity from the middle cranial fossa.
3) **Floor**- formed by a thin plate of bone, separating the middle ear cleft from the internal jugular vein and jugular bulb.
4) **Medial wall** –formed by the petrous part of the temporal bone, which separates the tympanic cavity from the inner ear. The prominence of the anterior end of the lateral semicircular canal wall is present postero-superiorly on its surface.

   The prominence of the facial canal is present Antero-inferiorly on its surface, and the depression of the oval window is present immediately below it.

   The Cochleariformis process lies anteriorly on the medial wall surface and the tensor tympani tendon passes through it. The promontory, which is the prominent bulge formed by the basal turn of the cochlea is also present on the medial wall and the tympanic plexus lies over it. Round window mesh lies right below the promontory and is closed by a secondary tympanic membrane

The sinus tympani is the depression present below the ridge of the facial canal, medial and inferior to pyramidal eminence and behind the promontory.

5) **Anterior wall**-Formed by a thin piece of bone separating it from the internal carotid artery. Eustachian tube and canal wall of tensor tympani muscles opening is also present on it.
6) **Posterior wall**- continuous with the posterior wall of EAC containing, the vertical segment of the facial nerve.

ARTERIAL SUPPLY

1) Anterior tympanic artery from maxillary artery.
2) Inferior tympanic artery from ascending pharyngeal artery.
3) Stylomastoid artery from the posterior auricular artery.
4) Superficial petrosal and superior tympanic branches of the middle meningeal artery.
5) Carotico-tympanic artery from the internal carotid artery.

VENOUS DRAINAGE

Vein drain into the pterygoid plexus or superior petrosal sinus.

LYMPHATIC DRAINAGE

Drain into the retropharyngeal and parotid group of nodes.

NERVE SUPPLY

Via the tympanic plexus:

1) Glossopharyngeal nerve.
2) Carotico-tympanic nerve from internal carotid plexus.

EUSTACHIAN TUBE:

The Eustachian tube also known as the pharyngo-tympanic tube is a funnel-shaped structure. Extending from the tympanic ostium lying superiorly on the anterior wall of the tympanum to the pharyngeal ostium located just posterior to the inferior nasal concha.

The pharyngo- tympanic is directed downwards forward and medially toward its pharyngeal end. In adults,the tympanic ostium is present approximately 1.5-2 cm higher than the pharyngeal ostium. The length of the Eustachian tube is variable, and may vary from 31 – 38 mm. the medial $2/3^{rd}$ of the tube is cartilaginous, whereas the lateral $1/3^{rd}$ is bony. The cartilaginous and bony part of the tube meets at an angle of 160^{o} forming the isthmus, which is the narrowest part of this tube.

The dimensions of the tube are following:

1) The vertical diameter is 3-10 mm.
2) Horizontal diameter is 2-4mm.

The isthmus is 1mm in width and 2mm in height. The tympanic orifice is 2mm in width and 5mm in height and the pharyngeal orifice is 5mm in width and 9mm in height.

PARTS OF THE EUSTACHIAN TUBE

1) **Bony part**: It is approximately 12mm in length, its widest part being the tympanic opening, from where it slowly narrows down towards the isthmus and gets almost flattened. The osseous part lies between the tympanic plate and petrous part of the temporal bone, below the canal for tensor tympani. Peri-tubal air cells around osseous part are extensions of cells arising in the tympanic cavity.
2) **Fibro-cartilaginous part**: it is a slit-like passage of about 23- 26 mm in length passing downward forward and medially towards the pharyngeal orifice. It is an elongated triangular sheet with its apex at the isthmus and base, directed anteromedially towards the pharynx. The cartilage is confined to the upper and medial part of the Eustachian tube and fibro-connective tissue known as salpingo-pharyngeus fascia forms the lateral wall of the tube.

The torus tubarius is a Eustachian cushion formed by the medial lamina of the cartilage as it gradually thickens towards its pharyngeal end.

The Eustachian tube is lined by ciliated columnar epithelium which thins towards the osseous part transforming into cuboidal tympanic mucosa, with a few mucus glands. Fibro-cartilaginous part is rich in sero-mucinus gland and is lined by pseudo-stratified epithelium, which contains goblet cells towards the pharyngeal end. Numerous lymphoid aggregates are present in the sub mucosa.

ARTERIAL SUPPLY

1) Pharyngeal branch of ascending pharyngeal artery.
2) Pharyngeal branch of the internal maxillary artery.
3) Ascending palatine branch of the facial artery.
4) Superior tympanic branch of middle meningeal and the artery of pterygoid canal.

VENOUS DRAINAGE

The veins drain into the pterygoid plexus.

LYMPHATIC DRAINAGE

To the retropharyngeal and deep cervical nodes.

NERVE SUPPLY

Sensory innervations; is via the tympanic plexus and so through the IXth NV.

Muscles related to the Eustachian tube

1. **Tensor palati**- it arises from the inner plate of the pterygoid plexus and inferior surface of the sphenoid bone, some fiber also arises from the membranous part of the tube. It has a greater effect on the contraction of the Eustachian tube, than on the soft palate, as its tendon is very firmly attached to the hamular process. It gets its supply from the mandibular division of Vth NV.

As the person swallows this muscle opens the lumen of the Eustachian tube, and equalizes the middle ear pressure, and in its resting phase this muscle is responsible for the closure of the eustachian tube

2. **Levatorpalati**- this muscle of the inferior surface of petrous part of the tympanic bone, bordering the carotid canal. The round body of this muscle runs parallel to the tube and forms the floor of the membranous part of the tube. It is inserted into the soft palate right below the pharyngeal orifice. It gets its supply from the vagus through the pharyngeal plexus. Its main action on the Eustachian tube is raising the floor of the tube by shortening and swelling of its fiber.
3. **Salpingo-pharyngeus**- is a slender muscle attached to the inferior part of the cartilaginous part of the tube near its pharyngeal orifice, from where it descends to blend with the palatopharyngeus.

Mastoid antrum and mastoid air cells

Mastoid antrum:- is an air filled sinus located within the petrous part of the temporal bone, communicating with the middle ear, through aditus with mastoid air cells, arising from its wall. It is 14mm from front to back, 7mm from side to side, and 9mm from top to bottom. The medial wall of the antrum is related to the posterior semi-circular canal, with its roof forming the floor of the cranial fossa. The bony covering of the sigmoid sinus forms its posterior wall. Supra-meatal triangle present on the lateral surface of the temporal bone forms the lateral wall.

Mastoid air cells:- it is a system of interconnected air-filled cavities that arise from the walls of the mastoid antrum, and sometimes, also from the epitympanum and mesotympanum walls.

Allam classification of pneumatized spaces of the temporal bone.

1) **MIDDLE EAR REGION:**
    a) Mesotympanic area
    b) Epitympanic area
    c) Hypotympanic area
    d) Protympanic are
    e) Posterior tympanic area

2) **MASTOID REGION:**
    a) Mastoid antrum area

       Peripheral mastoid areas: tegmental, sinodural, sinal, facial, and tip cells.
3) **PERILABRYNTHINE REGION:**
    a) Supralabrynthine area
    b) Infralabrynthine area
4) **PETROUS APEX REGION:**
    a) Peritubal area
    b) Apical area
5) **ACCESSORY REGION:**
    a) Zygomatic area
    b) Squamous area
    c) Occipital area
    d) Styloid area

Mastoid air cells are lined by non-ciliated squamous epithelium. Extensively pneumatized mastoid air cells are called cellular, poorly pneumatized air cells are called acellular or sclerotic & partially pneumatized air cells are called diploic cells.

PHYSIOLOGIC CONSIDERATION

The tympanic membrane receives sound waves through the walls of the EAC. The tympanic membrane not only acts as a tensile elastic membrane but also has a displacement of 2400cps, calculated by the movements of the tympanic membrane. The entire coned portion of the tympanic membrane & the handle of the malleus moves around a central line passing through anterior and lateral processes. The spot of most significant amplitude is the inferior edge, being +2400cps. The tympanic membrane moves in a segment, with the manubrium movement delayed compared to the tympanic membrane. Mass of incusand malleus are uniformly distributed up and down along the central line of rotation; since they are attached with ligaments, they move as a part. On exposure to pressure, the incus, malleus, and stapes move along with the tympanic membrane.

-<u>lower ʊ sound</u>- moves along the lower post pole.

-higher υ sound-moves along the long axis.

Reducing the chances of damage to the organ of Corti.

Tensor tympani and stapedius also play a role in guarding extremes of sound. Tensor tympani causes the inward movement of membrane and the handle of malleus, and stapedius pulls the stapes footplate outward from the oval window, so as block the movement of the chain. The stapes also responds to the acoustic reflex and low υ restriction to eliminate masking effect. Significant loss of energy occurs at the boundary of the mediums, so as to cover this loss middle ear cavity acts as an advocate.

The conduction of small pressure made on the stapes footplate is magnified by the actions of the middle ear and phase differential.

TYMPANIC MEMBRANE-

- Effective area: 43 mm^2
- Total surface area:69 mm^2
- Area of footplate: 3.2mm^2

Thirteen fold reduction in the area of the stapes footplate, leads to a significant pressure at the oval window. Also, as the handle of malleus is longer than the long process of incus, an additional leverage of around 1.3 is available. Thus, the pressure exerted at the footplate is about 17 times greater than the tympanic membrane.

The middle ear transformer mechanism thus reduces the input impedence of inner ear from the theoritical 5600 to 193cps units and the amount of sound energy reflected from the tympanic membrane is sufficiently reduced for a normal functioning acoustic system.

The middle ear also has another function of sound protection of the round window. The sound energy, normally, therefore, passes through the oval window into the cochlea, for, if both the windows were exposed equally to sound, little transfer of energy would occur because it would be opposed by the inertia and incompressibility of the fluids of cochlea. An intact tympanic membrane, therefore has a vital role to play in the round window protection, because sound

waves transmitted through it go through the ossicular chain,into the oval window and thence to the inner ear.

Aeration of the middle ear is the main function of the eustachian tube. Under normal conditions, the gases in middle ear are slowly absorbed by capillaries of its walls, thus creating a negative pressure in middle ear. The tube opens intermittently and equalizes the pressure difference. If the pressure gradient is reversed, the air may pass in the opposite direction. In normal individuals, thepressure differential between the middle ear and nasopharynx needed toaffect the air flow in between 0.5 to 4 mm of Hg. pressure differential of 20 to 40mm. of Hg. is needed to force air into the middle ear if associated with muscular activity (as in valsalva's manouevre). Escape of ear from the middle ear through the closed tube will occur, however, with a pressure difference of as little as 12mm. of Hg. Locking of the tube will occur if the pressure difference between the two cavities is more than 90mm of Hg. Another important function of the eustachian tube, aided by gravity and ciliated epithelium is to drain the fluid from the middle ear. This function is particularly important after middle ear surgery.

Finally, the tube has a protective function. The resting tube protects the ear from noise and pressure changes in the nasopharynx, and probably acts as a barrier to infection[21] The present day knowledge of the function of the Eustachian tube reveals certain broad facts like normally the tubes are closed. They open during the acts of swallowing, yawning and sneezing. They exhibit no independent reflex dilatation either periodic or irregular. Although an important function of the tube is that of equalizing the pressure on both sides of the tympanic membrane, mere regulatory the existence of a disturbed pressure equilibrium will bring about no reflex dilatation of the tube, either independently or through the swallowing reflex. Deglutition as a means of restoring pressure equilibrium to the ear drum is performed, when necessary, consciously or through habit, but this reflex is never set in motion directly by the stimuli arising from tension of the tympanic membrane.The tensor palati is the only muscle which is functionally related to the eustachiantube.Contractionofthismuscleisalwaysaccompaniedbya dilatation of the tubal orifice. There is no constrictor muscle of the tube. Relaxationof the tensor palati is followedby a passive return of the tubal walls to the condition of approximation which they normally occupy when at rest.

Finally,ventilation of the middle ear is an extremely complex and dynamic process. The traditional thinking, that gases come up atthat eustachian tube, are trapped and gradually absorbed, then replenished with the next swallow, may be simplistic. First, the function of the tube as an air valve fluctuates constantly. Leclers et al[22]have shown that tubal opening time varies not only with position(upright or recumbent)but also the nasal cycle. The degree and duration ofopening also varies, and has been measured at 0.29 secs inadult females and 0.33 secs 'in children[23].The efficiency of tubal opening on swallowing was shown to vary with 81.9% efficiency among the adults and only 61.9% among children. Young adults have an intermediate efficiency of 74%[24].The rate of gas absorption also varies depending on the state of mucosa. Sade[25] has proposed that, rather than simple absorption, there may be an active bi directgas exchange at the mucosa! level, with some gases absorbed and others liberated into the middle ear

PATHOLOGYOFEUSTACHIANTUBEOBSTRUCTION

i) Three type of anatomical obstruction have been encountered in cases of chronic suppurative otitis media undergoing surgery.

A.Mucosalo edema

B.Cicatrical stenosis

C. Osseus block

A.MUCOSALOEDEMA:

Eustachian tube obstruction in these cases may vary from mild degree of mucosal odema leading to slight impairment of function to the total occlusion of tube[26.27].The tube may be blocked by polyploidal cystic mucosa orgranulations filling the hypotympanum and theeustachian tube because of the chronic suppuration. Fortunately, this condition isreversible in most of the cases with adequate medical and surgical treatment.

Wullstein[27] highlighted an interesting feature of the mucosal dysplasia of the tubo-tympanic region.Sometimes the air pocket over the round window may be obliterated even though the

eustachian tube is patent. In such cases, the hypotympanum is blocked by polyploidal granulating mucosa. Operative results are not satisfactory in such cases because of impairment of round window function. Wullstein stressed the need of thorough treatment of diseased mucosa of hypotympanum during operation, thus, opening up the hypotympanum and the eustachian tube and restoring the normal ventilation ofthe round window.

Healthy middle ear mucosawith a functioning eustachian tube predicts a successful tympanoplasty, in general[28].In some cases, the obstruction may be due to diseased mucosa occludingthe tubal lumen.In such cases,the Eustachian tubes were irradiated so as to establish the tubal patency.

B. CICATRIAL STENOSIS

Cicatrical adhesions may block the eustachian tube at the isthmus or in the hypo tympanum.Such cases are difficult totreat because ofthe strong tendency of cicatrics to form again, even after excision Zollner[29] used an acrylic tube extending from the tympanic end of the tube, through the nasopharynx, to the nostril in order to inflate air into the middle ear during post operative period.He claimed good results with this technique, but Wullstein[27]reported that the ultimate results with this procedure were disappointing.

C. OSSEUS CLOSURE

Osseous closure of the eustachian tube is very rare. Wullstein[27] successfully opened up such a closure with the help of a drill from the tympanic end ofthetube, but warned about the potential danger of injuring the internal carotid·artery during drilling and also during probing of the tube. He preferred to have a burr hole in attic, just like a control hole, in such cases, or left a small opening in the tympanic membrane graft in the region ofthetube.Plester[30] left a small opening in the region of the round window. However, Wullstein and Plester concluded that even though these methods provide an alternative opening for middle ear ventilation but ultimate. results are less likely to be satisfactory due to mucosal infection resulting in chronic discharge.

ii) Farrior[31] mentioned about 2 types of Eustachian tube obstruction.

a) Central
b) Peripheral

a) CENTRAL

The central obstruction was said to be due to chronic infection of naso- pharynx with concomitant lymphoid tissue hyperplasia resulting inavalve like closure at the pharyngeal orifice and it can neither be detected by politzerization,as swallowing overcomes the valve like closure action, nor by eustachian catheterization as it bypasses the obstruction.It could only be detected by Valsalva's manouevre, and usually the pharyngeal orifice opens up at a pressure of 20-30 mm of Hg.In the presence of a nasopharyngeal disease, as high as 90 mm of Hg. pressure was noted to inflate the tube during valsalva'smanouevre.Fortunately, this type of tubal dysfunction is reversible by medical, surgical orirradiation therapy to naso-pharynx.

b) PERIPHERAL

It was said to be due to irreversible fibrotic narrowingat the isthmus from a long standing chronic inflammation. Tympanopalsty was contra-indicated in presence of this blockage.

TEST FOR EUSTACHIAN TUBE FUNCTION

From the days of Valsalva, many tests and manouevres havebeen employed for the evaluation of the patency of the eustachian tube. These often have wrongly been called the eustachian tube function tests, since they only givean idea about the patency of the tube, but not necessarily the functional capacity of the tube.Some of these tests are still in clinical use.eg.Politzer's, Valsalva's and Toynbee's manouevre. Advent of tympanplasties led to the evolution of the newer tests which could estimate the Eustachian tube function more precisely.

Oonaldson[32] summarizes the Eustachian tube tests as tests of

A) Tubal patency valsalva,politzerization
B) Tubal transport
a) Of air (pressure-swallow equalization test,sonotubometry)

b) Of non physiologic media(contrast)

Dye clearance tests,Saccharin test,sequential contrast CT.

The various tests that have been evolved so far can be grouped under the following headings:

A) QUALITATIVE:-these include

a) Valsalva's manouevre:

The manouevre of AntonioValsalva, involves middle ear auto inflation by instructing the test subject to expire forcefully and swell the cheek while keeping his nose pinched and mouth closed. Nasopharyngeal pressures amounting to 3200 mm of H_20 may be attained by this procedure. The mean pressure essential to force open the tube is calculated to be approximately 600 mm of $H20$[33]. The test has both subjective as well as objective components. The subject records the sense of passage of air into the ear while objectively the tubal passage is indicated by the murmur heard on auscultation of the external auditory meatus. Lucae and Hartman noted an increased resistance to valsalva's test when the subject flexed his head and in the prone position and a decrease in resistance following section of the Vth nerve and shrinkage of the nasal mucosa[34].

b) Toynbee's manouevre:

The patient is asked to swallow with his nose closed while the otologist observes the drum under the microscope.If the tube is patent and functioning, an inward movement of the tympanic membrane may be noted.This test is of importance only when positive, since a negative test does not rule out normal function of the tube.

c) Frenzel manouevre[35]:

The manouevre was described in 1938, by Hermann Frenzel, and has been found to be more effective than the Valsalva or Toynbee test.With the nostrils and glottis closed, the air in the nasopharynx is compressed by the muscles of the base of the mouth and the tongue. The opening of the eustachian tube by this method is facilitated by the convexity of the tongue

which places the soft palate and parts of the tube orifice to which it is connected into a more favourable position for opening thetube.

The advantage is that it can be performed in any phase of respiration and is independent of intrathoracic pressure.The disadvantage is that the procedure has to be learned,but once acquired it so on becomes unnecessary to hold the nostils as these close automatically.

d) Politzerization:

The procedure of Politzer, includes application of a positive pressure through the nose while the patient approximates his soft palate to the oropharynx.

The air is introduced with a politzer bag connected to an olivary nozzle.Thenozzle isinserted into thenostril ofthe affected sideto close it and the other side of the nose is pinched shut.The closure of the nasopharynx is achieved by having the patient swallow a sip of water or repeat the letter"k" several times in succession.The momentthe "Adam's apple" is seen to begin to rise, the politzer bag is sharply compressed expelling airthrough the closed nasal cavity. Successful inflation is accompanied by a crackling noise on auscultation and a visible movement of eardrum on otoscopy.

e) Eustachiantubecatheterization:

Nose is sprayed with a local anaesthetic, and an auscultation tube is adjustedbetween the patient'sear and the examiner's ear.The Eustachian catheter is then slowly introduced along the floor of the nose until it touches the posterior nasopharyngeal wall.The catheter is withdrawn a little from the.posterior pharyngeal wall and rotated 30^0 laterally into the fossa of Rosenmuller. The catheter is then drawn slightly forward over the bulging posterior lip of the eustachian orifice into the mouth of tube. Another method of introducing the eustachian catheter is that on reaching the posterior pharyngeal wall, the catheter tip is first rotated medially by 90ºand pulled proximally until it touches the posterior edge of the septum.Finally it is rotated 180° laterally, after releasing it slightly backwards until it is fitted into the tubal orifice. A politzerbag is fitted with the catheter and air is forced through it by squeezing the bag, and the sound is listened in the auscultation tube.

A soft blowing sound indicates tubal patency. A moist bubbling sound indicates that there is fluid in the middle ear cavity, and absence of sound signifies a blocked tube. eustachian catherization, if properly performed, and if there is no anatomical blockage of the tube, usually gives a positive result.Therefore, it cannot be used as a diagnostic test for assessment of the eustachian tube function[36].

B) QUANTITATIVE:these include

a) Flisberg and Millder's method:

Flisberg, lnglestedt and Ouertergren[10] put forth a method to quantitatively determine the eustachian tube function, based on the physiological function of the eustachian tube.An artificial negative intra-tympanic pressure was created in the middle ear through a perforated drum and the capacity of the eustachian tube to reduce the negative pressure in the tympanum by repeated swallowing was noted, in the form of step like tracings using a manometer system, comprising of a pressure transducer, amplifier and aminiograph. The minimal negative pressure necessary for tubal opening is used as a quantitative measure of eustachian tube function. Millder, using the same principle devised another apparatus for assessment of the eustachian tube functions and expressed the results in following categories.

i) Eustachian tubes opening with positive and negative intra- tympanic pressure
ii) Eustachian tubes opening with positive but not with negative intra tympanic pressure
iii) Eustachian tubes not opening at all

TECHNIQUE:

A tympanic membrane perforation is a prerequisite for it. A syringe is used to produce either a positive or a negative pressure, not to exceed 30mm of Hg. This is the pressure above which eustachian tube block may occur, which maymake itdifficult for apatient toberelieved ofthis locking by ordinary auto inflation technique. If a negative intra-tympanic pressure is produced and the eustachian tube is normal, swallowing will allow air to enter the closed system and bring the pressure back to zero.In a hypo-functioning tube, the negative pressure, which

remains in the system after a series of ten swallows is arbitrarily used as the functional capacity of the tube under negative pressure When positive pressure isused, the patient is instructed not to swallow during the time the barrel of syringe is slowly pushed inwards. The least amount of positive pressure required to open the tube, is the capacity of the tube under positive pressure.

(b) lmpedence Audiometry:

The principle utilised is essentially the same as in the Flisberg and Millder's technique. Holmquist[37]objectified the measurements by providing a constant middle ear pressure of -200 mm of Hg using an impedance audiomter. The patient was asked to swallow four times. A normally functioning eustachian tube was characterized as one which was able to bring the -200 mm of Hg pressure in the middle ear to zero by the end of four swallowings.

(c) Sonotubometry[38]:

It is among one of the newer techniques of quantifying the eustachian tube function.This technique actually tests the ability of the eustachiantube to transmit sound waves through it.The principle of sono tubometry was introduced by Potitzerin 1869.He demonstrated the opening of the eustachian tube during swallowing by observing that a tuning fork in front of the nostrils could be heard louder during swallowing . In 1939 , Pearlman introduced modern.electronics to this principle utilizing low frequency test sounds.Since then many attempts have been put to apply this test in the clinic.In this technique,sound,generating device is placed at one end of the tube (external auditory canal) and a probe which can detect sound waves is placed near the other end(in the nasal cavity).A specific number of sound stimuli are generated at the nasal end and the probereceivesthestimuliat the aural end. The percentage of stimuli recieved out of the total generated reflects the efficiency of eustachian tube. This gives a direct measure of the openingofthetubeanddoesnotrequireaperforated tympanic membrane. The immediate advantage of sonotubometry as a measure of tubal function is that it is a passive test.

(C) TYMPANIC CAVITYCLEARANCE STUDIES:

These tests identify the ability of the eustachian tube to clear the tympanic cavity of certain substances e.g.contrast ,saccharinetc .These include:

(a) Contrast Radiography:

House[39]conceived the idea of filling the tympanic cavity with a radio opaque contrast medium and noting the emptying time in an effort to evaluateeustachian tube functions. A series of films were taken of his own ear by injecting a water soluble dye through the lower portion of the drum into the tympanic cavity. The attic, tympanic cavity and eustachian tube were clearly visible. After he had chewed the gum for 10 minutes, the tympanic cavity was almost cleared. This classical experiment laid the foundation stone of a new diagnostic procedure for assessment of the eustachian tube function i.e. the tympaniccavity clearancestudy, which was developedby Compere[40].

If the eustachian tube is normal,clearance of the dye from the tympaniccavity to the nasopharynx should be complete in ten minutes.If the tube is obstructed,the site of obstruction will be easily visualized.

In chronic secretory and suppurative otitis media,where thickened mucosa may act as a one way valve,the patient my be able to inflate the tube,but there will be obstruction to the clearance of the contrast medium. In conditions like tumours of the fossa of Rosenmuller and acute secretory otitis media, the eustachian tube may be obstructed to inflation but the clearance of the contrast will be normal.Obstruction to middle ear clearance denotes disease at the tympanic end of the tube, whereas, obstruction to infaltion denotes disease at the pharyngeal end of the tube.

(b) Saccharintest:

Carried out by Elbrond and Larsen[41]first. This test assesses the mucociliary function of the eustachian tube. The cilia present in the mucosal lining of the eustachian tube, beat in a direction from the tympanum towards the nasopharynx, thus, clearing the middle ear off the secretions. In this test, a crystal of saccharin is placed, through a perforation in the tympanic membrane, at the tympanic end of the eustachian tube and the patient is asked to report as soon as he percieves the sweet taste of Saccharin. The normal time as reported by Elbrond and Larsen has been around 30 to 40 minutes[41].

(c) FlouresceinEndoscopy:

This test is based on the ability of the eustachian tube to clear the tympanic cavity of a flourescein dye that is placed in the tympanic cavity through a perforation in the tympanic membrane.

The basis of this approach was suggested by Kirchner and Proud[42] when they described a flourescent dye technique for the localization of cerebrospinal fluid ottorhoea and rhinorrhoea. Since then this techniuqe has been used by many workers with good results forestimating eustachian tube functions.

Rogers et al[11],inthis study on 50 patient with dry as well as discharging ears with a safe perforation found out that the dye appears in the nasopharynx within 10 minutes after being instilled into the test ear in case with normally functioning eustachian tube.Whereas, with a blocked eustachian tube,itdoes not appear at all.

Guindy[12],compared the endoscopic study as a method of eustachian tube functionevaluation tomanometric method.Inhisstudy on 80cases withadry central perforation, he found out that endoscopic study of tubal function was equally effective ameans ofestimating eustachian function as manometry.

Another comparative study ofmethods ofevaluating eustachian tubefunction insafeCSOM was carried out bySen[43].Hemade a comparison between the endoscopic dye clearance and impedence audiometry as methods for evaluating eustachian tube function in 50 cases with safe CSOM. Based on thedata obtained fromthe study of50cases who underwent thedyetest, the eustachian tube function was graded as follows:

(a) Hyperfunction:Dye appears within 4 minutes
(b) Normalfunction:Dye appears after 4 minutes and upto 6 tragal pressures.
(c) Hypofunction:Dye appears after 7 to 20 tragal pressure
(d) Obstruction:Dyefailstoappearsevenafter20tragalpressures

In·this study too, both the dye test and impedence audiometry gave similar results.

In this, a flourescein dye is installed into the middle ear through a tympanic membrane perforation and the eustachian tube orifice is examined with an endoscope to look for the dye. The time interval between the installation of tube and its exit into the naso-pharynx isnoted. This method hasbeen shown to be equally effective to the manometric method of assessing the tubal function[58].The use of nasopharyngeal endoscopy has made the flourescein dye test more specific and has also proved indispensible in diagnosing mechanical tubal obstruction and hidden tubal pathologies. The dye used in the procedure has the advantages of being a relatively inert dye (sensitivity reactions < 0.5%) and is easily visible in the nasopharynx on endoscopy besides being quite economical.

SURGICALCONSIDERATION:

MYRINGOPLASTY:

It is an operation performed to repair or reconstruct the tympanic membrane using a graft material.

Approach:

Permeatal, endaural or postaural approach could be used for the procedure.

Graft materials used:

Modern myringoplasty was started by Wullstein[44]and Zollner[45] who repaired the tympanic membrane perforation with skin grafts.The results were disappointing because of the problems of crusting, cholesteatoma formation and graft break down. Search for a better material continued.The use of autogenous collagen as graft material greatly improved the success rate. Herrman[46] was the first to use temporalis fascia.Ringerberg[47] introduced fat and Goodhill[48] used tragal perichondrium with good results.There is now a general consensus that connective tissue grafts can be safely used by underlay technique.Presently the most frequently used graft materials world wideare autologous temporalis fascia and tragal perichondruim.

Technique:

The graft material could be placed medial (underlay technique) or lateral (overlay technique)to the fibrous annulus.

GroupI	unsatisfactory	Closure ofAB gap within 20-30 dB or more of the pre operative level
GroupII	Satisfactory	Closure of AB gap within10-20 dB of pre operative level
GroupIll	Good	Closure of AB gap within 0-10 dB of pre operative level.

The functional results following myringoplasty in terms of hearing improvement are divided according to international classification into[49]:

CORRELATION BETWEEN EUSTACHIAN TUBE FUNCTION AND MASTOID

PNEUMATIZATION AND MYRINGOPLASTY:

Since the advent of tympanoplasty in 1953, various authors related the failure in tympanoplasty to the eustachian tube dysfunction.

Flisberg et al[10]put forth a manometric test based on physiological function of the eustachian tube. They obtained good results of myringoplasty in patients with a normally functioning eustachian tube as compared to those with a non functioning eustachian tube.Miller and Bilodeau[50] correlated thepreoperative eustachian tubefunction as assessed by manometric method, with the results of tympanoplasty. They divided the tubal function into three different grades depending upon the quality of eustachian tube function. They obtained good results of tympanoplasties in 77%, 35% and 18% cases respectively in three different grades divided in order ofquality ofthe tubalfunctions.

Schuknecht & Kerr[51]employing the manometric method for assessing eustachian tube function also found that a normally functioning eustachian tube was essential for success in myringoplasty.

Siedentop et al[52] examined 25 cases after myringoplasty, and observed that all the successful post operative cases had good eustachian tube function, whereas, the failed cases demonstrated poor eustachiantube functions.They further emphasized that the results of tympanoplasty could be safely predicted only in 40% of the cases on the basis of the pre operative assessment of eustachian tube function and mastoid pneumatization,although,in their

study,there was no specific correlation between pre operative eustachian tube function,mastoid pneumatization and results of surgery.Eustachian tube functions were assessed by manometric method and mastoid cellularity was assessed based on lateral x-ray mastoids using planimetry. The measured mastoid air cells were divided into 3 groups depending on the area of mastoid air cells.

(a) smallsize: 0-4.9cm^2
(b) mediumsize:5-9.9cm^2
(c) largesize:10cm^2

They found that 67% of cases with good eustachian tube function and large mastoid cell size and only 24% had small sized cells.

Holmquist[37] reported good post operative results in 75% of the cases with good preoperative tubal functions as assessed by manometric methods as compared to only 12% of the cases with poor preoperative tubal function. Holmquist further observed that cases with good tubal function had good mastoid cellularity and also post operative results, whereas, ears with poor tubalfunctions hadpoorcellularity of the mastoid and gave bad post operative results.

An interesting classification of cases for tympanoplasty was established and published in 1970 by Belluci[2]based on the following criteria:

(a) History of onset of infection
(b) Unilateral or bilateral involvement
(c) Relationship between ear and nasal infection
(d) Tests of Eustachian tube function

(e) Pathology of tympanic membrane and middle ear mucosa

(f) Character of ear discharge

(g) Radiography

Table I:

	Group	**%of postoperative patients with trouble free ear at 2 years**
(A)	Good prognosis	88%
(B)	Fair prognosis	56%
(C)	Poor prognosis	24%
(D)	Very poor prognosis	8%

Contrary to the above observations, successful myningoplasty was reported in 80% of the cases with poor eustachian tube functions as assessed by manometric technique byMackinnen[53]. Out ofthese, 29% of the cases had very poor eustachian tube functions.

Ekvall[54] also reported 100% good post operative results inthe cases with poor Eustachian tube functions, as assessed by Valsalva's maneuver pre operatively.

PaivaandKarja[55]did not find any definite relationship between pre operative functional capacity of the tube and the operative results,in a series of 120 tympanoplasties. 83% success was obtained in cases with normal eustachian tube functions and normal middle ear mucosa.

Sharp[21] reported 82% successful myringoplasties even in cases with poor tubal functions.

Dutta et al[36] reported 87.5% good results in cases with good eustachian tube functions as assessed by manometric methods, and in 69% ofcases with poor tubal function they got good graft take up butpoor hearing gains.

Tos[49]obtained over 80% good results in cases with both good and poor functioning eustachian tubes, whereas nonfunctioning tubes gave only 53% good results.

Sengupta and Kacker[56·] assessed eustachian tube function using manometric methods in 204 cases and myringoplasty was performed in104 cases. In cases with normal tubal function, perfect healing was observed in 91.3% of cases with satisfactory hearing gain in 85.5%. Whereas, in cases with hypofunctioning tubes, healing was observed in 70.5% of cases with satisfactory hearing gain in 64.5% cases.

Elbrond& Larsen[41] assessed the eustachian tube function in 44 patients with a dry central perforation and found a correlation between the hearing improvement obtained as determined by postoperative air-bone gap and the eustachian tube functions as assessed by saccharin test.

Hassan & Moustafa[57]assessed eustachian tube function using a manometric method in 62 cases. They had a 100% graft take up rate in cases with normal eustachian tube function as compared to 80% in cases with abnormal tubal functions. Further, good hearing gain was achieved in 100% of the cases with good eustachian tube function as compared to 75% in cases with malfunctioning tubes.

Jonathan[58]in his study on 25 patients found no significant association between pre operative eustachian tube function and outcome of myringoplasty.

Guindy[12]assessed eustachian tube functions in 80 cases with central perforation by means of manometric method and flouresceing endoscopy and divided the patients into 3 groups:

Group I (48 cases): Normal tubal function as assessed by normal manometric and endoscopic findings. The perforation closure rate in this group was 95.8%.

Group II (22 cases): Mechanical tubal obstruction as indicated byabnormal manometric and endoscopic findings

Group Ill (10 cases): functional tubalobstruction as indicated by abnormal manometric and normal endoscopic findings.

Out of the 32 cases with tubal obstruction, normalization of tubal function by correction of the nasal and peritubal pathology could be achieved in17 cases with a perforation closure rate of 94% on myringoplasty. In the remaining 15 cases, the perforation closure rate was 66.7%.Biswas[59]used impedence audiometry for assessing eustachian tube function in 575 cases with central perforation. He observed that poor eustachiantubefunctionwasassociatedwithahighfailurerate(70%) whereas a normal eustachian tube function was associated with a high success rate both in terms ofgraft take up and hearing gain (~ 76%).

There is general agreement that healthy middle ear ventilation is crucial for the success of tympanoplasty[60], despite the fact that no test is recognised as a conclusive indicator of eustachian tube function. However, there is no agreement on how to figure this out. In fact, a prominent panel decided in 1996 at the international Politzer society meeting in Budapest that preoperative evaluation of eustachian tube function is not necessary and is not useful.

THEORIES OF PNEUMATISATION.

According to Wittmaack's theory, the meconium in the uterus could prevent the pneumatization of the mastoid air cells. He separated the pneumatization process into three phases.

First- Begins5thor 6th fetal month and continues to the end of first year of life.

Second- From the 1st year to 4th year oflife.

Third- Continues from 4th year of life.

He added that in typical circumstances, the mastoid process pneumatizes during the fourth and fifth year of life. Adrecht, Barth, Schwarz, and others agree with this point of view.

According to Mouret and Portman, the expansion of the temporal bone includes more than only the formation of air gaps.determines the pneumatization process. According to Reudi, the thickness of the tissue that borders or fills the pneumatic spaces has no bearing whatsoever on how such spaces develop.

Diament believed that genetic factors play a role in the pneumatization of the mastoid bone and claimed that the hypocellularity of the mastoid is a hallmark of childhood upper respiratory illnesses[61]. According to Reudi, sclerosis of the mastoid air cells observed in chronic otitis media results from infection rather than from infection itself. According to Thorborn, eustachian tube occlusion is not always a sign of a sclerosed mastoid.

In their investigation of 200 individuals, Pakira et al[62] came to the conclusion that normal pneumatization cannot take place if the middle ear is invaded by an exudative pathology brought on by eustachian tube dysfunction.

The function of the eustachian tube appears to be specifically correlated with the pneumatization of the mastoid process. Intact, a number of researchers, including Takasaka[63] and Giebink[64], have hypothesised that a dysfunctional mucociliary system is one of the contributing factors of recurrent otitis media and, consequently, a poorly pneumatized mastoid process.

Using planimetry, Zaidi[65] determined the degree of mastoid pneumatization in 80 individuals (including those with and without a history of URTI). He came to the conclusion that people with a history of either low grade middle ear infection or other similar contributory variables, such as recurrent upper respiratory tract infection, typically have a smaller overall mastoid sizeA possible explanation for this could be the vacuum effect in the middle ear, which exerts negative pressure on the delicate bony trabeculae, encouraging cohesiveness and preventing expansion or enlargement of the mastoid air cell system, or the inhibitory effect of low grade infection on the osteoblastic activity of the mastoid bone. The middle ear's biochemical alterations, such as the altered pH, have also been recognised as key contributors to mastoid sclerosis.

Arora et al[66] conducted a study on 100 cases of chronic suppurative otitis media and found that the severity of the sclerosis was directly correlated with the length of the sickness. The cases with CSOM had a relatively poor degree of mastoid pneumatization in comparison to healthy individuals.

In their study of 69 kids with chronic middle ear disease, Shea & Lindman[67] came to the conclusion that chronic middle ear disease is substantially correlated with inadequate mastoid pneumatization.

Whether mastoid pneumatization can change or be inhibited by inflammatory disorders, or whether partial pneumatization indicates a pathogenic change, is still unknown. Variable pneumatization is discovered to be genetically determined[68]. The size of the skull is another factor that differs by race. The development of the skull's skeleton is the key element.The size of each mastoid is determined by the eventual size of the skull in each individual[70]. For example, an acromegalic[69] skull has a thick, huge expansive mastoid, whereas a microcephalic skull has a small underdeveloped mastoid.

Mastoid pneumatization is also influenced by mucociliary system dysfunction, repetitive otitis media, and eustachian tube dysfunction[65]. Acute or chronic middle ear inflamatory and atelectatic disorders are frequently a complication of eustachian tube dysfunction that causes middle ear aeration[71].Never ignore the mastoid while discussing middle ear pathology. The mastoid air cell system, which is a component of the middle ear cleft, is frequently affected by the disorder. If not looked into and examined, mastoid pathology may extend back to the middle ear and result in a repeat of the illness. If the middle ear is invaded by an exudative pathology as a result of eustachian tube obstruction, normal pneumatization cannot take place.The mastoid air cells sclerosis as a result. With or without cell septa rupture, it begins as a faint haze over the mastoid air cells. On x-rays, it appears as a dense shadow[65].

Unknown is the mastoid's function in the middle ear aeration. However, it serves as a surge tank and an air reservoir to reduce pressure fluctuations[72]. The condition of the mucosa likely affects the pace of gas absorption. At the mucosa! level, it has been claimed that there is an active, bidirectional gas exchange with certain gases being absorbed and others being released into the middle ear[25].

SIZE OF MASTOID AIR CELL SYSTEM

The size of the mastoid in various races and age groups has been the subject of numerous research in the past. The findings of a few prominent investigations are as follows:

Table 2 (Next page)

	No.ofcases	Meanofallagegroups (cm^2)
Diament(1940)[73]	328	12.04±0.37
Flisberg & Zsigmond (1965)[74]	11	12.69±0.81
Andreasson (1976)[75]	59	12.70±1.86
Aroraetal(1973)[76]	100	12.05±0.67
Chatterjee, Ghosh &Ghosh (1990)[77]	50	11.45±0.70

In the most recent study, conducted by Chatterjee et al[77], the range of mastoid area size for age groups older than 15 years was 8–22 cm^2.

MATERIALS & METHODS

MATERIAL AND METHODS

The present study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery of Santosh deemed to be university ,from Oct 20 to April 22.

The patients were selected according to the following criteria:

(a) INCLUSION CRITERIA

- Age between 18 to 45 years
- Unilateral safe C.S.O.M.
- Dry ear for more than 6 weeks.
- Conductive hearing loss only.

(b) EXCLUSION CRITERIA

- Bilateral C.S.O.M.
- Unsafe C.S.O.M.
- A.S.O.M.
- SNHL
- Coexisting nasal pathologies eg.nasal polyps,cleft palate,allergic rhinitis, etc.
- Recent episode of U.R.I.
- External auditory canal pathologies eg.Otitis externa,otomycosis etc.

METHODS:

All of the cases were carefully questioned, looked at, and investigated, with the results being documented in the proforma.

HISTORY:

A thorough history of the complaints made, as well as historical events, personal information, and family background, was logged. It was specifically enquired into how long the ear had been dry. We asked about and documented any problems of the nose and throat. Additionally noted were any prior surgeries or otorrhoea-related drugs that may have been used in the past.

CLINICAL EXAMINATION:

In addition to a comprehensive ear, nose, and throat examination, it included a complete physical examination of the patient.

Theearswereexamined for:

- any external deformity.
- Any discharge in the external canal.
- perforation in the tympanic membrane , which was diagrammatically represented on the proforma.
- Status of the middle ear mucosa
- Seigelization was done in every case
- Subjective Valsalva's test: the patient was instructed to blow into their cheek with their lips closed while forcing air into their ear. The findings were interpreted by using the patient's account of air entering the ear as a sign of a positive Valsalva.

INVESTIGATIONS

All the selected patients were subjected to the following investigations:

- Hemogram and urine.routine examination.
- PTA.
- X-ray mastoid Law's lateral oblique view:The area of the mastoid air cells of the patients were assessed from the above mentioned X-ray using planimetry.

PROCEDURE:

The patient's X-ray film was held over the viewing box while the pneumatized area was copied on butter paper and then onto a graph sheet.

Calculate the area - Squares that are entirely or mostly within the copied area were counted as one. However, those that were partially or completely outside of the duplicated area were not counted.The area of the patient's mastoid air cells was calculated as the sum of all the squares.

Flourescein nasopharyngoscopy:

The patients eustachian tube function was evaluated using this approach. Patients were given a thorough explanation of the process before being escorted to the operating room, where 10% xylocaine was administered in each nostril to provide local anaesthesia.

Procedure-

The 20% solution of flourescein sodium dye, diluted 1 to 5, was utilised. After properly suctioning the patient's external auditory canal, 15 drops of the dye were inserted into the test ear, the ear canal was plugged with a cotton wick, and the patient was instructed to sit, flex their head to a 45-degree angle, and tilt their head 45 degrees in the direction of the untested ear.

PROCEDURE OF NASAL ENDOSCOPY

The nasopharyngeal aperture of the eustachian tube was examined using a nasal endoscope with its tip soaked in blue textliner ink. The patient was instructed to swallow ten times.

SURGICAL PROCEDURE:

1. **PRE-OPERATIVE PREPARATIONS**:The night before the procedure, the 2 inch hairline area surrounding the affected ear was shaved. The patient was administered the following medications 30 minutes before the procedure.

injection pethidine:50 mg. Intramuscularly

injection phenergan:25 mg.Intramuscularly

By injecting 0.5ml of 2% xylocaine intradermally and watching for any sensitivity reactions, all of the patients underwent a xylocaine sensitivity test.

2. **OPERATIVE TREATMENT**:Under local infiltration anaesthesia and sedation, all cases were operated on using a LABOMED operating microscope. The same surgical team operated on each instance using the postaural route and the auto temporalis fascia graft and underlay procedure.
3. **POSTOPERATIVEFOLLOW UP**:Outerbandagewasremovedafter48hours.

A systemic antibiotic of flouroquinolone group was routinely given orally for one week.After one week, the soframycin pack from the canal and the sutures were removed, and the gelfoam condition was recorded. When it was discovered that 17 individuals had a mucopurulent discharge from the external auditory canal, antibiotic-steroid ear drops were immediately administered to each patient, and oral antibiotic therapy was continued for an additional week.

Pre and post operative audiograms were compared to assess the hearing gains following operations.

The results of myringoplasty have been attempted to be correlated with the preoperative status of eustachian tube functioning and mastoid pneumatization.

OBSERVATIONS & RESULTS

OBSERVATIONS

Between April 2021 and April 2022, a total of 50 cases of dry central perforation underwent surgery while having their mastoid pnuematization and Eustachian tube function assessed.

These cases were followed up for periods varying from 2 months to 6months.

AGE & SEX INCIDENCE:

TABLE 3

Agegroupsinyears	No.ofcases	Percentage
11-20	6	12%
21-30	19	38%
31-40	20	40%
41-50	5	10%
Total	50	100%

(P.T.O)

TABLE 4

Duration	Otorrhoea	Deafness
0-11months	4	1
1-5years	31	8
6-10years	7	-
11-15 years	5	-
>15.years	3	-
Total	**50**	**9**

Maximum number of patients were in the age group of 21-40 years (78%) Male: female ratio in the present study was (1:1.38) 21:29.

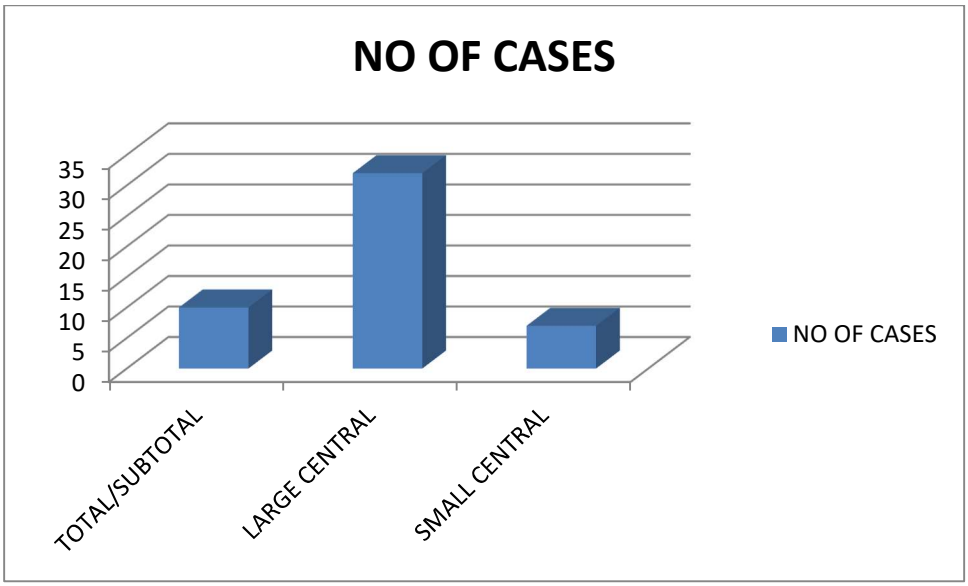
Signs: The tympanic membrane perforation in the patients varied from small central perforation (involving one quadrant) to sub total/total perforation.

TABLE 5

Showing size of perforation of tympanic membrane

Size of perforation	No.of Cases	Percentage
Subtotal/total	9	18%
Large central	33	66%
Smallcentral	8	16%
Total	**50**	**100%**

Figure I:Showingdistributionofthesizeof perforation



SIZE OF PERFORATION

A big central puncture was present in the majority of cases (66%). When the pars tensa was completely perforated except for the annulus, this was referred to as a subtotal perforation.

Large central perforation was when more than one tympanic membrane quadrant was affected.

ASSESSMENTOFHEARING:

Rinne's test was found to be negative in all but 3 of the affected ears. Absolute bone conduction was normal in all cases.

Pure tone audiometry was carried out in all the cases. Table 6 showsthe results in three speech frequencies (500 Hz, 1000 Hz and 2000 Hz).

TABLE 6 : Showing average degree of hearing loss(Pre-op PTA)

Hearingloss	Numberofcases	Percentage
10-19 dB	6	12%
20-29 dB	35	70%
30-29dB	8	16%
40-49dB	1	2%
Total	**50**	**100%**

The above table indicates that the 43 cases (86%) had hearing loss in the range of 20-39 dB.

EUSTACHIAN TUBE FUNCTIONS:TABLE 7(RESULTS OF VALSALVA MANOEVURE)

Tubal function	Number of cases	Percentage
Patent	32	64%
Blocked	18	36%
Total	**50**	**100%**

The above table indicates that the tube was patent on inflation in 32 cases (64%) subjectively and in 18cases (36%), Valsalva manouevre was negative.

TABLE 8 Showing the results of fluorescein dye method

	Number of cases	Percentage
1. Dye appearing in nasopharynx within10 minutes	34	68%
2. Dye appearing after 10 minutes/notappearing atall	16	32%
Total	**50**	**100%**

The above table indicates that out of the 50 cases, 34 cases (68%) had a patent tube and 16 cases (32%) had a blocked tube as assessed by the dye clearance endoscopic assessment.

TABLE 9 Showing the area mastoid air cells inCSOMcases

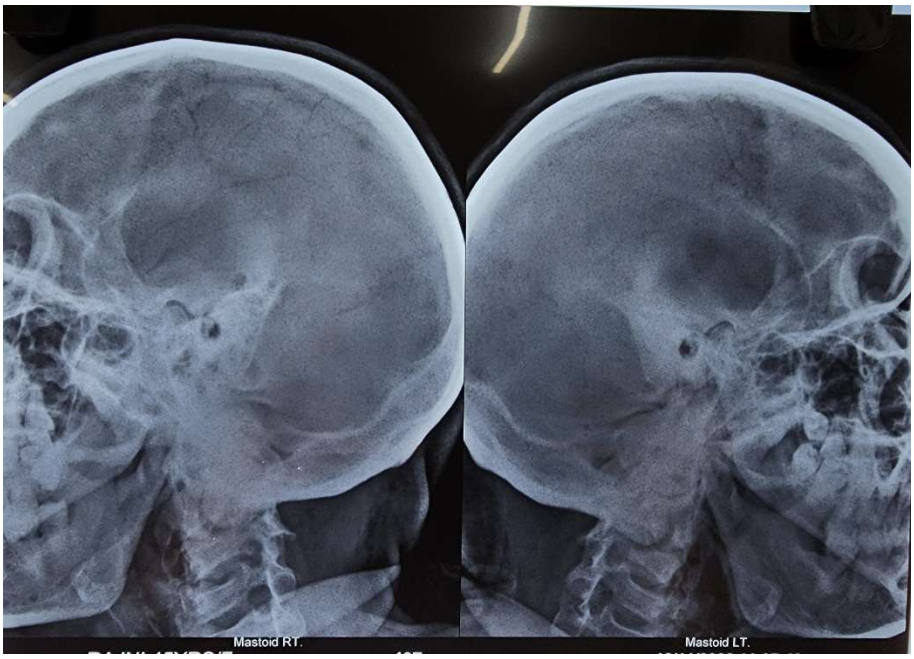
Area of mastoid air cells	Numberofcases	Percentage
$8cm^2$	24	48%
$<8cm^2$	26	52%
Total	**50**	**100%**

The above table shows that 24 cases out of 50 (48%) had well pneumatized mastoid air cell systemin the diseased ear as opposedto 26 cases(52%) who had a poor pneumatization.

TABLE 10 Showing area of mastoid air cells in normal ears

Area of mastoid air cells	Number of cases	Percentage
$8cm^2$	42	84%
$<8cm^2$	8	16%
Total	**50**	**100%**

MASTOID RADIOGRAPHS (B/L SCLEROTIC)



WELL PNEUMATISED

TABLE 11 **Showing condition of middle ear mucosa at operation**

CONDITION OF MIDDLE EAR MUCOSA	NO. OF CASES	%
PALE/NORMAL	40	80
HYPERTROPHIED/POLYPOIDAL	10	20
TOTAL	50	100

POST-OPERATIVE PERIOD:

After a week, the gauze pack was removed from the external auditory canal. Twenty-three patients received both local treatment and systemic antibiotics for ear discharge (ranging from mucoid to mucopurulent). Out of them, six patients were under control and still had an intact tympanic membrane at four weeks. Small tympanic membrane perforations were present in five patients; these were successfully cauterised and patched with cigarette paper. At the end of the

first and second months, twelve patients showed failure to accept the graft and had significant perforation.

FOLLOW UP:

The patients were followed up with visits at 4thand 8thweek and were assessed in terms of graft take up and hearing improvement at the end of 8 weeks.

TABLE 12 **showing the results of graft take up at 8 weeks**

Results	Number of cases	Percentage
Graft accepted	38	76%
Graft rejected	12	24%
Total	**50**	**100%**

FUNCTIONAL IMPROVEMENT:

Functional results were assessed by puretone audiometry. Hearing improvement was assessed accordingto international classification in which cases are divided into 3 groups[49].

GroupI	Unsatisfactory	Closure of AB gap within 20-30dB or more of the pre operative level
GroupII	Satisfactory	Closure of AB gap within10-20dB of pre operative level
GroupIII	Good	Closure of AB gap within 0-10dBof pre operative level.

Table 13 Showing the percentage of functional successful cases

Functional improvement	**Number of cas es**	**Percentage**
Good	15	39.4%
Satisfactory	13	34.2%
Unsatisfactory	10	26.3%
Total	**38**	**100%**

According to the above table, 34.2% of the patients improved well, while 39.4% of successful cases demonstrated good functional improvement. In 26.3% of the cases, the functional improvement was insufficient.

Correlation between pre operative status of eustachian tube function and mastoid pneumatization and myringoplasty results:

TABLE 14 showing correlation betweeneustachian tubepatency and graft take up

Tubal function	**Totalcases**	**Grafttaken** **No.** (%)	**Failure** **N.** (%)
Patent	34	26 (76.47)	8 (23.53)
Blocked	16	12 (75.00)	4 (25.00)
Total	**50.**	**38 (76)**	**12 (24.00)**

According to the aforementioned table, of the 34 cases with patent eustachian tubes, 26 (76.47%) had grafts implanted at 8 weeks, while 8 cases (23.53%) experienced failure. In contrast, of the 16 cases with blocked eustachian tubes, 12 (75%) had grafts implanted at 8 weeks, while 4 cases (25%) experienced failure.

Statistical conclusion:FISHER EXACT test applied:

p value > 0.05

Insignificant correlation.

TABLE 15 showing correlation between eustachian tube patencya nd functional results of myringoplasty in 38 successful cases

Tubal function	Number of cases	Good	Satisfactory	Unsatisfactory
Patent	26	10	8	8
Blocked	12	5	5	2
Total	**38**	**15**	**13**	**10**

According to the aforementioned table, out of a total of 26 successful cases with a patent eustachian tube, 10 cases (38.46%) had favourable hearing outcomes, 8 cases (30.76%) had adequate outcomes, and 8 cases (30.76%) had insufficient outcomes. However, out of the 12 successful cases with blocked Eustachian tubes, 5 (41.66%) had tolerable hearing results, 5 (41.66%) had good hearing results, and 2 (16.66%) had unsatisfactory results.

Statistical conclusion: FISHER EXACT test applied

P value> 0.05

Insignificant correlation

FIGURE 2 Showing graft take rate against tubal function

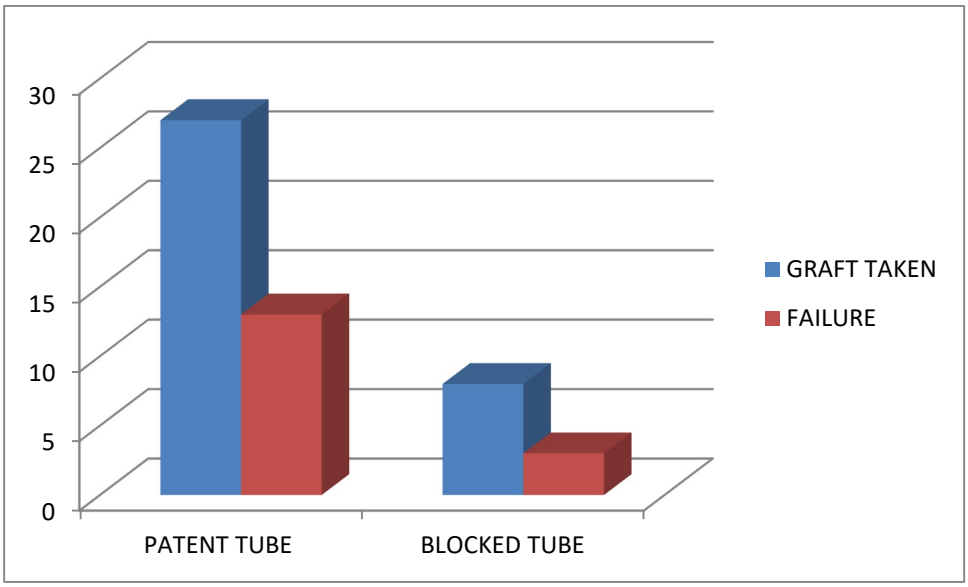


FIGURE 3 showing hearing improvement in successful cases against tubal function

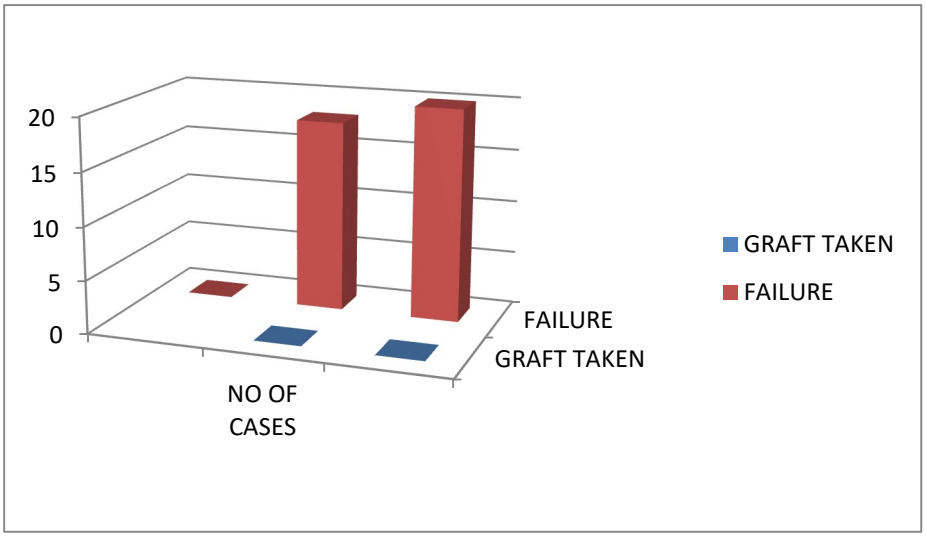


TABLE 16 showing correlation between mastoid pneumatization and graft taken up

Areaofmastoid	TotalCases	Graft taken No. (%)	Failure No. (%)
8cm(well pneumatization)	24	18(75)	6 (25)
<8cm(poor pneumatization)	26	20 (76.92)	6 (23.08)
Total	**50**	**38 (76)**	**12 (24)**

According to the aforementioned table, of the 24 cases with a well-pneumatized mastoid air cell system, 18 cases (or 75%) had a graft accepted, while six cases (or 25%) had a failure. In contrast, of the 26 cases with a poorly pneumatized mastoid air cell system, 20 cases (or 76.92%) had a graft accepted, while six cases (or 23.08%) had a failure.

Statistical conclusion:CHI-SQUAREtest

applied: P value> 0.05

Insignificant correlation

TABLE 17 Showing correlation between degree of mastoid pneumatizationand functional results in 38 successful cases

Areaofmastoid air cells	No. ofcases	Good	Satisfactory	Unsatisfactory
$8cm^2$	18	8	4	6
$<8cm^2$	20	7	9	4
Total	**38**	**15**	**13**	**10**

According to the aforementioned data, eight (18) of the successful cases with well-pneumatized mastoid air cells had good hearing results, four (22.2%) had satisfactory results, and six (33.3%) had unsatisfactory results. While 7 (35%) of the 20 successful cases with inadequate mastoid pneumatization had good hearing outcomes, 9 (45%) had satisfactory outcomes, and 4 (20%) had dismal outcomes.

Statisticalconclusion:FISHEREXACTtest

applied: P value> 0.05

Insignificant correlation

Figure4:showing graft taken rate against mastoid pneumatization

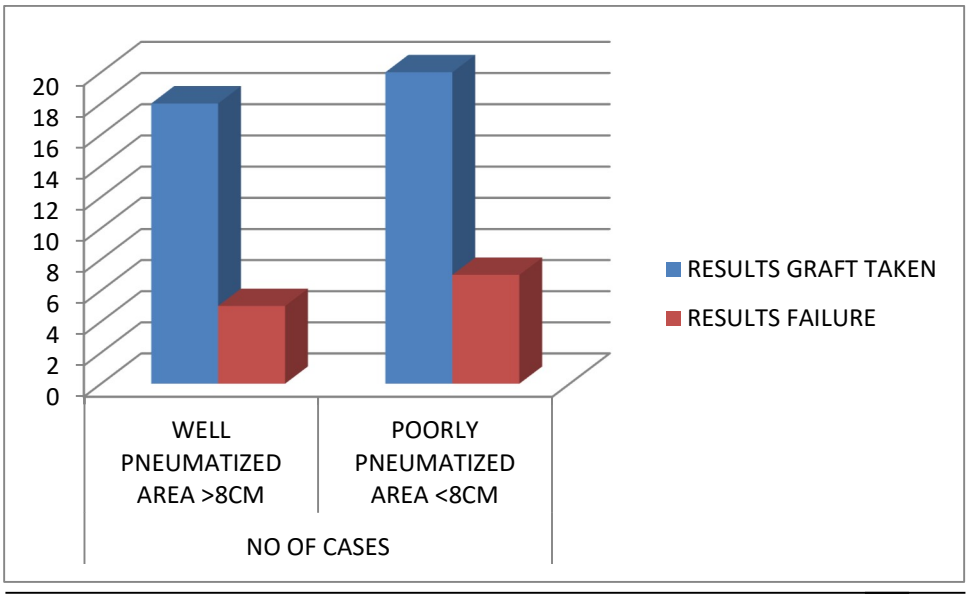


Figure5:showing hearingimprovement in successful cases against mastoid pneumatization

TABLE 18 showingcorrelation between Eustachian tube functionand mastoid pneumatization and graft take up.

Patientcategory	Cases	Graft taken	Failure
Well pneumatized with patent tube	15	11	4
Well pneumatized with blocked tube	8	6	2
Poorly pneumatized with patent tube	19	15	4
Poorly pneumatized with blocked tube	8	6	2
Total	**50**	**38**	**12**

According to the above table, out of a total of 15 patients with well-pneumatized mastoids and patent eustachian tubes, 11 instances (73.33%) had successful graft take up when both parameters, i.e., mastoid pneumatization and eustachian tube function, were taken into account. In contrast, six out of eight instances (about 75%) of closed eustachian tubes and weakly pneumatized mastoids had grafts take up. While 21 instances (77.77%) of the other group of 27 patients—which included either blocked or badly pneumatized mastoids with the other component as normal—had a transplant take up.

Thereby, it clearly indicates that there is no apparent correlation between the combined influence of eustachian tube functional status and degree of mastoiq pneumatization on the outcome of myringoplasty.

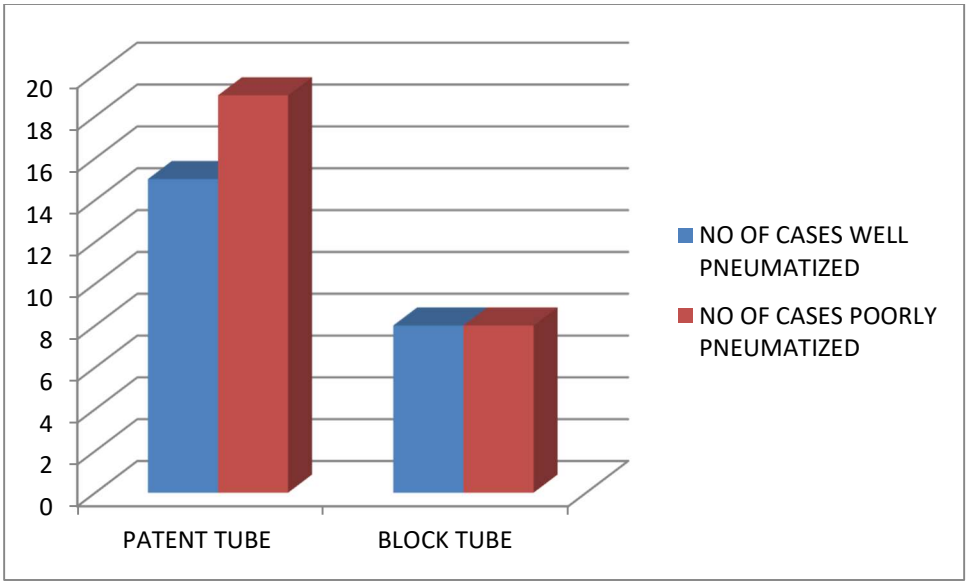
Statisticalconclusion:FISHEREXACT test applied:

P value> 0.05 Insignificantcorrelation

TABLE 18: Showing correlation between eustachian tube function and mastoid pneumatization

Eustachian tube status	Mastoid pneumatization	
	Well pneumatized	Poorly pneumatized
Patent	15	19
Blocked	8	8

FIGURE 5 Showing correlation between eustachian tubefunction and mastoid pneumatization



Statisticalconclusion:CHISQUARE test applied

P value->0.05

Insignificant correlation

DISCUSSION

DISCUSSION

The goal of the current study was to analyse the value of mastoid pneumatization and fluorescein dye clearance as preoperative indicators of eustachian tube function in reconstructive aural surgery. Additionally, the study sought to determine the relationship between mastoid pneumatization and eustachian tube performance.

A total of 50 cases of unilateral central perforations in adults between the ages of 18 and 45 were examined using eustachian tube function tests and mastoid x-rays. Considering that this was not a population-based study, there was no control group.

The minimum age requirement of 18 was set since all patients would undergo local anaesthesia during surgery, which would have been uncomfortable for those who were younger. The upper age restriction of 45 years was established because presbycusis is more common in this age group and because older age groups are at higher risk for systemic diseases related to the cardiovascular system.

A few of the earlier research looked at age groups ranging from 9 to 61 years (Jonathan)[58], 16 to 72 years (Holmquist)[37], 8 to 72 years (Holmquist and Hallen)[78], and 5 to 74 years (Virtanen et al)[79].

Deafness and ear discharge symptoms could last anywhere between six months and fifteen years, and the most frequent size of perforation was big central (66% of the time). Despite the fact that Belluci[2] has integrated these two elements. in his classification of the prognosticfactors for tympanoplasty,but these are not included in the parameters under this study.

Because the flourescein dye clearance method provides useful information on the eustachian tube patency as well as its capacity to clear middle ear secretions, it was utilised to evaluate eustachian tube function. Within 10 minutes after the dye's injection into the middle ear, the dye can be seen at the nasopharyngeal end of a healthy eustachian tube. According to Rogers et al[11], a delay of more than 10 minutes indicates a blocked or underperforming tube. According to Guindy[12]'s comparison study on 80 cases and Sen's[43] comparative study on 50 cases, using this method to assess eustachian tube function has been found to be just as effective as manometric methods, such as impedence audiometry. . The fact that only a relatively small number of studies

in the past have employed this method for preoperative assessment of eustachian tube status and that the results in these studies have been inconsistent is another reason why this method is preferred for evaluating eustachian tube function. In the current investigation, out of a total of 50 cases, the tube was determined to be patent in 34 cases (58%) and blocked in 16 cases (32%). In the absence of any other nose or throat pathologies, the eustachian tube. While the tube was discovered to be obstructed in 25% of instances in the study conducted by Rogers et al[11], Guindy[12] discovered that the tube was blocked in 40% of cases. 20% of the cases had blocked tubes, according to Sen[43]. For assessing tubal function, flourescein dye was utilised in all of these experiments. Thus, our findings are consistent with these research. By employing the manometric approach for evaluating tubal function, Jonathan[58], Moustafa et al[57], MacKinnon[53], Sengupta and Kacker[56], and Biswas[59] found that the incidence of eustachian tube obstruction was 48 percent, 15 percent, and 30 percent, respectively. These two approaches seem to produce results that are somewhat comparable when estimating Eustachian tube functioning.

Since there is a trustworthy link between planimetric and volumetric measurements of the mastoid air cell system[74], planimetry was used to estimate the cellularity of the mastoid bone. It was discovered that the average area of mastoid air cells in sick ears (ears with safe C.S.O.M.) ranged from 6.8 cm^2 to 13 cm^2. It was discovered to be larger than what Flisberg& Zsigmond[72] noted in their analysis of 49 instances with safe C.S.O.M., in which they discovered that the mean size of the mastoid air cell system was 4.4 cm^2. While Holmquist[80], Siedentop[52], and Arora et al. reported the mean area of the mastoid air cell system in otitic ears to be 6.3 cm^2, 5.5 cm^2, and 1.3 cm^2, respectively. Therefore, our outcome is comparable to those of Holmquist[80] and Siedentop[52].

The range of area of mastoid air cells in the non-otitic ears was found to be from 4 to 22 cm^2 with the mean at 10.8cm^2 in this study. Chaterjee et al[77], who in their study on 50 Indian cases, found the mean size of the mastoid air cell system to be 11.45 ± 070 cm^2. It was found to be 12.04± 0.37 cm^2 by Diament[73], 12.69±0.81 cm^2 by Flisberg[74], 12.70±1.86 cm^2 by Andreasson[75] and 12.05±0.67 cm^2 by Arora et al[76]. The result of present study are similar to these study.

The size of the mastoid air cells system, as determined by planimetry, was used to split the ears into two groups: those with areas of 8 cm^2 and those with areas of less than 8 cm^2. This division was also based on a study by Chaterjee et al[77], which determined that the mastoid air cell system

ranges in size from 8 to 22 cm^2 their investigation into 50 Indian cases. While 26 cases had 8 cm^2 regions in the current investigation, 24 cases were found to have this size.

Out of the 50 instances, it was found that 38 (76%) had their grafts successfully implanted, whereas 12 cases had a failure. Eight transplant failures out of a total of 34 instances with a normally functioning eustachian tube (23.53%), compared to four graft failures out of a total of 16 cases with a dysfunctioning eustachian tube (25%). The FISHER EXACT test was used to analyse this finding and found no significance (P value = 1.00), indicating that there is no relationship between graft uptake and eustachian tube function in this instance.

Successful graft take-up occurred in 38 cases, and in 28 of those cases (or 73.6%), the improvement in hearing was satisfactory or good. 18 instances (69.22%) of the 26 successful patients (out of 38 cases) with a healthy eustachian tube had acceptable or good hearing improvements. On the other hand, 10 patients (83.34%) of the 38 successful cases with a dysfunctional eustachian tube had satisfactory or good hearing gains. There is no link between eustachian tube function and post-operative hearing gain in this observation, according to the FISHER EXACT test (P value = 0.4528).

18 cases (or 75%) of the 24 cases with well-pneumatized mastoid air cells (area 8 cm^2) showed good graft take-up. Twenty cases (76.14%) of 26 patients with poorly pneumatized mastoid air cells (area 8 cm^2) showed effective graft take-up. There is no link between the degree of mastoid pneumatization and graft take up in this observation, according to CHI- SQUARE (P value = 0.873).

Twelve (66.6%) of the 18 effective cases (out of 38 cases) with a well-pneumatized mastoid air cell had acceptable or good hearing improvements. 16 cases (or 75%) of the 20 successful cases (out of 38 cases) with poorly pneumatized mastoid air cells had acceptable or good hearing gains. There was no link between the degree of mastoid pneumatization and post-operative hearing gain in this observation, according to the FISHER EXACT test (P value = 0.486).

This study's success rate for graft take up was 76%, which is close to the results from other studies by Miller & Bilodeau[50] (77%), Holmquist[37] (75%), Mackinnen[53] (80%), Paiva & Karja[55] (83%) and Sharp[21] (82%). According to the study, there is no connection between preoperative eustachian tube status, mastoid pneumatization level, and myrigoplasty outcomes.

This stands in stark contrast to the findings that some of the earlier researchers in the study had reached. Only 33% of blocked eustachian tube procedures were successful, according to Miller & Bilodeau[50], and only 12% of blocked tubes were successful, according to Holmquist[37], as opposed to 75% of patent tubes. Belluci[2] added mastoid pneumatization level and eustachian tube function as significant prognostic indicators for tympanoplasties. In addition, Tos[49] reported subpar outcomes (53%) for blocked tubes as opposed to 80% for patent tubes. Both poor and regularly functioning eustachian tubes had an equally good graft take up result, according to Dutta et al[36]. Patients with impaired tubal functioning were shown to have an inadequate post-operative hearing gain. According to Sengupta and Kacker[56], patients with normal tubal functioning had graft take-up rates of 91% and satisfactory hearing gains of 85%, compared to those with impaired tubal function who had graft take-up rates of 70% and satisfying hearing gains of 64%. According to Guindy[12], instances with patent eustachian tubes had success rates of 95%, whereas cases with clogged tubes had success rates of 66.7%. When tubes were patent, Biswas[59] saw success rates of 76%, whereas success rates for tubes that were blocked were only 30%. With properly pneumatized mastoid air cells, Holmquist[80] reported a success rate of 70% as opposed to 57% with inadequately pneumatized mastoid air cells. In the current investigation, a graft took up in 76.4% of instances with a patent eustachian tube.

Mackinnon[53] observed that in 80% of the cases with malfunctioning eustachian tubes, the graft took up successfully. 100% success rates were also reported by Ekvall[54] for patients with compromised tubal functioning. Similar to this, Paiva & Karja[55] had 83% success with both blocked and patent tubes but did not discover any relationship between preoperative eustachian tube function and the surgical outcomes. Even in circumstances with suboptimal tubal function, Sharp[21] achieved 82% success. Even with obstructed tubes, Jonathan[58] reported a success rate of 67%. The graft takeup in this trial is also 75%, even in the presence of a blocked eustachian tube.

Even if there are quite a few research available, it is quite challenging to compare the current study with any other studies or, even, any two studies in their entirety. This is due to the fact that there are other factors that are taken into consideration, such as the length of the illness, the presence of any other E.N.T. pathology, the status of the middle ear, the method used to estimate tubal function, etc. It is impossible to standardise any of these factors when comparing the current study to earlier research.

It was discovered that 15 cases (or 44%) out of the 34 patent tube cases had a well-pneumatized mastoid air cell system. In contrast, 8 cases (or 50%) of the 16 cases with blocked eustachian tubes had well-pneumatized mastoid air cells. There is no link between the patency of the eustachian tube and mastoid pneumatization, according to the results of the CHI SQUARE test (P value = 0.697).

Genetic factors[68], overall skull growth[69], an individual's height, and eustachian tube functions[70] have all been linked to the pneumatization of the mastoid air cell system. Pakira et al[62] found that eustachian tube dysfunction is to blame for poor mastoid pneumatization in their study of 200 patients. Shea[67], Zaidi[65], Arora et al[66] share the same opinion. Holmquist[80] also connected a compromised mastoid air cell system with a deficient tubal function. The problematic middle ear mucosa, which may or may not be due to an improperly functioning eustachian tube, is thought to be more closely associated with the poor degree of pneumatization in the studies listed above than the pathological eustachian tube itself. This could be the cause of the lack of an association between the degree of pneumatization and eustachian tube functional status in the current investigation.

In the current research, 10 instances had middle ear mucosa that was polyploidal at the time of surgery. Six of these patients (about 60%) experienced graft failure. The status of the middle ear mucosa may therefore be regarded as a significant element in the current investigation, but this finding cannot be drawn because the data are insufficient for drawing such conclusions and drawing such conclusions is outside the scope of the aims and objectives of the study.

It is clear from this study, as well as from previous research by Mackinnon[53], Ekvall[54], Paiva and Karja[55], Sharp[21], and Jonathan[58], that myringoplasty produces positive results in a significant number of cases with poor eustachian tube function and poor mastoid cellularity. However, regardless of the tubal functions or mastoid pneumatization, sick middle ear mucosa may have a significant role.

Poorly pneumatized mastoid air cells or a hypofunctional eustachian tube should not be regarded as an absolute contraindication to myringoplasty, according to the current study, which found good results in such situations.

At this point, it is important to emphasise that the flourescein dye method provides an idea of the anatomical patency of the tube. However, a blocked tube by this study does not necessarily imply that the block is permanent, as even tubal mucosa edoema can prevent the dye from passing through and give the appearance of a blocked tube. However, because the series is so tiny, it is impossible to draw a firm conclusion from the current study. The usefulness of preoperative assessment of eustachian tubefunction and degree of mastoid pneumatization will be determined by a subsequent study with a larger study group and a longer follow up.

SUMMARY

& CONCLUSION

SUMMARY AND CONCLUSION

- The goal of the current study was to analyse the relationship between mastoid pneumatization and eustachian tube function as well as the preoperative condition of the eustachian tube and its importance in reconstructive aural surgery. Inactive safe chronic suppurative otitis media cases were evaluated for eustachian tube function by flourescein dye clearance and nasopharyngoscopy, and the degree of mastoid pneumatization was evaluated by planimetry before the patients had myringoplasty.
- 50 cases with unilateral safe chronic suppurative otitis media in either sex, ranging in age from 18 to 45 years, were included in the study.
- 20–40 dB conductive hearing loss was present in 43 instances (86%) and significant central perforation was present in 33 cases (66%) of the cases.
- 34 instances (68%) had a patent tube, compared to 16 cases (32%), which had an obstructed tube.
- The patients had Law's'lateral oblique x-rays of the mastoid, and planimetry was used to determine the extent of the mastoid air cells. In twenty-four cases (48%) the mastoid air cell system was well pneumatized, while in 26 cases (52%) the system was not well pneumatized. 8 cm^2 was measured as being well pneumatized and anything less as being poorly pneumatized. The average area of pneumatization was determined to be 6.8 cm^2 in otitic ears and 10.8 cm^2 in non-otitic ears.
- The graft was accepted in 38 cases (76%) and the hearing improvement was satisfactory in 28 cases (73.6%).
- 26 instances (76.47%) of the 34 patients with patent eustachian tubes saw effective graft take-up, and of these, 18 cases (69.22%) experienced favourable hearing gains. While 12 (or 75%) of the 16 cases with blocked eustachian tubes underwent effective graft take-up, and of these, 10 (or 83.34%) had favourable hearing outcomes.
- Out of the 24 instances with well-pneumatized mastoid air cells, 12 cases (66.6%) had favourable hearing improvements, and 18 cases (75%) had good graft take-up. Out of the 26 instances with inadequately pneumatized mastoid air cells, however, 20 cases

(76.92%) had successful graft take-up, and of these, 16 cases (80%) showed favourable hearing gains.

- 15 cases (44%) of the 34 patients with a patent eustachian tube had well pneumatized mastoid air cells. In contrast, eight cases (or 50%) of the 16 blocked eustachian tube cases had well-pneumatized mastoid air cells.
- At the time of surgery, it was discovered that 10 out of a total of 50 cases had a polyploidal middle ear mucosa, and 6 of these instances (or 60%) experienced graft take-up failure.

WE CONCLUDE THAT:

- The results of myringoplasty in terms of graft uptake and postoperative hearing gain do not clearly correlate with the preoperative state of the eustachian tube as determined by the flourescein dye clearance method.
- Preoperative mastoid pneumatization level and myringoplasty outcomes in terms of graft uptake and postoperative hearing gain do not appear to be significantly correlated.
- The degree of mastoid pneumatization is unrelated to the functional condition of the eustachian tube.
- Chronic suppurative otitis media has a definite effect on the degree of mastoid pneumatization.
- Thecondition ofmiddle ear mucosa isanimportant factor intheoutcomes of myringoplasty.

REFERENCES

REFERENCES

1. WullsteinHL.Pastandfutureof tympanoplasty.ArchOtolaryngol(Chic.)1963;78:371.

2. Bellucci R J.Selection of cases and classification of tympanoplasty.Otolarygol Clin N Am. 1989;22{5}:911-26.

3. Eustachius B. Quoted from a history of otolaryngology.E& S Livingstone Ltd.,London 1949 pp 69.

4. Valsalva A. Quoted from a history of otolaryngology.E& S Livingstone Ltd.,London 1949 pp 39-40.

5. Toynbee J.Quoted by Compere.The diseases of ear, their nature, diagnosis and treatment.John Churchill .P,London 1958;190:215.

6. Politzer A.Quoted from a history of otolaryngology.E& S Livingstone Ltd., London 1949 p.p. 100.

7. Reverchen, Worms. Quoted by Compere. L'Explorationradiolagique au lipiodol enoto-rhino-laryngologie rev de laryng1958;46:189.

8. SpeilbergW.Visualization of the eustachian tube by the roentgen ray.ArchOtolaryngol 1927;5:330-340.

9. Compere, Wesley E. Tympanic cavity clearance studies. Trans Amer AcadOphthal and Otolaryngol 1958 (May-June) ; 62:444

10. Flisberg K, lngelstedt S, Orpegran U. Controlled "ear aspiration" of air,a physiological test of the tubal function . Acta Otolaryngol suppl 1963;182:35-38

11. Rogers et al. The evaluation of eustachian tubal function by flourescent dye studies. Laryngoscope 1962;72:456-66.

12. Ahmed El Guindy.A conservative manometric and endoscopic study of tubal function in dry central perforation of the tympanic membrane.JLaryngolOtol I991 (Sep.);105:716-20.

13. Anthony F.J. Middle ear reconstruction and eustachian tube.Ind J Otol 1996 (Dec.) 2(4) :151-153.

14. Paiva T. Surgical treatment of chronic middle ear disease, myringoplasty and tympanoplasty.ActaOtolaryngol 1987 ;104(3-4):279-284.

15. Silverstein H,Mcdaniel A B, Lichteastein R .A comparison of P.O.R.P.,T.O.R.P. and incus homograft for ossicular reconstruction in chronic ear surgery. Laryngoscope 1986 ;96(2): 159-165.

16. Black J H,Hickey H A Wormold P J. An analysis of the results of myringoplasty in children.Int J Ped Otolaryngol 1995 ;31(1): 95-100.

17. Foggia D A, Mccabe D F. Homograft tympanoplasty; the IOWA experience. Amer J Otol 1990 ;11(5) :307-309.

18.Wright A. Anatomy and. ultrastructure of the human ear.Scott Brown's Otolaryngology.Butterworth Heinemann ,Oxford1997,6 th ed;1:1/1-50.

19. PicklesJ0.Physiologyofhearing.Scott.Brown'sOtolaryngology.Butterworth-Heinemann; Oxford 1997,6 th ed.;1:2/1-34.

20. Von Bekesey G, Experiments in hearing.McGraw Hill Book Co. lnc,New York. 1960 pp 86.

32. DonaldsonJA.Physiologyofeustachiantube.Arch Otolaryngol 1973(Jan); 97(1):9-12.

33. Davison R A. Ventillation of normal blocked middle ear. Ann OtolRhinolLaryngol1965;64:537-545.

34. Lucae A. In function den lubaeustachii. Arch I Ohrenh1866 ;3:179.

35. Fitzerald A. Examinationof the ear. Scott Brown's Otolaryngology.

Butterworth-Hienemann,Oxford 1997 6th ed.3:1/1-29.

36. Dutta N N,Kacker S K,Sinha A. Eustachian tubal function in health and disease.Ind J LaryngolOtol 1971;23:163-175

37. HolmquistJ.Therole ofeustachiantubein myringoplasty. Acta Otolaryngol1968;66:289-95.

38. Lildholt T; Brask T,Hvidegaard T. Interpretation of sonotubometry. Acta Otolaryngol (Stockh.) 1984;98:250-254.

39. House W F. Tympanic cavity clearance studies. Trans Amer AcadOphthalOtolaryngol1958;62:44.

40. Compere WE. Tympanic cavity clearance studies.Otolaryngol Clin N Am1970;3(1):48.

41. Elbrond& Larsen. Mucociliary function of the eustachian tube. Arch Otolaryngol 1976(sep); 102 :539-41.

42. Kirchner F R, Proud M D. Localization of cerebrospinal fluid otorrhoea and rhinorrhoea. Laryngoscope 1960(July); 7:921.

43. Sen S, Guha S, Biswas A, Ghosh L M. A comparative study of methods of evaluating eustachian tube function in chronic suppurative otitis media. Ind J Otol 1999(June) ;3(2):67-70.

44. Wullstein H. (1952);Quoted by Lesinski S G.1983.

45. Zollner F. The principles of plastic surgery of the sound conducting apparatus. J LaryngolOtol1955;69:637.

46. Herrmann H. Tympanic membrane plasty with temporalis fascia.Quoted by Lesinski S G. 1968:1983.

47. Ringerberg J C. Closure of tympanic perforation using fat. Laryngoscope1978;88:982.

48. Goodhill. Quoted by Gosh S.(1980). Evaluation of failure of myringoplasty.Otolaryngology 1963;9:20.

49. Tos M. Assessment of the results of tympanoplasty. J LaryngolOtol1972;86:487-500.

50. Miller G F(Jr.), Bilodeu R. Preoperative evaluation of eustachian tube function in tympanoplasty. Southern Med J 1967;60:868.

51. Schuknecht H F, Kerr A G. Pathology of the eustachian tube . Arch Otolaryngol (Chic.)1967;86:497.

52. Siedentop K H, Tardy M E, Hamilton L R. Eustachian tube function. Arch Otolaryngol1988;88:386-395.

53. Mackinnon D M. Relationship between preoperative eustachian tube function and myringoplasty. Acta Otolaryngol1970;69:100-106.

54. Ekvall L. Eustachian tube function in tympanoplasty -clinical aspects. Acta Otolaryngol1970;263:33-42.

55. Paiva A, Karja J. Eustachian tube patency in chronic ears. Preoperative evaluation correlated to postoperative results. Acta Otolaryngol1970;263:25-28.

56. Sengupta R P, Kacker S K. Study of eustachian tube function with particular reference to long term follow up in myringoplasty. Ind J Otol 1974(Sep.);26(3):132-137.

57. Hassan M M, Salem M, Abdel Latif, Shaaban B M. A simple apparatus for the assessment of eustachian tube patency before myringoplasty. J LaryngolOtol 1979(Jan.);93:39-42

58. Jonathan DA. The predictive value of eustachian Tube function(measured with sonotubometry) in the successful outcome of myringoplasty. Clin Otolaryngol 1990 ;15: 431-34.

59. Biswas A. Eustachian tube function test:a new dimension in the management of C.S.O.M. Ind J Otol 1999(Apr.-June);51(2):14-21.

60. Riedel C L, Wiley T l, Block M G.Tympanometricmeasuresof eustachian tube function. J Speech Hearing Research 1987;30(2):207-214.

61. Tumarkin A. On the nature & vicissitudes of the accessory air spaces of the middle ear. J LaryngolOtol1957;71:65-137.

62. Pakira B B, Barua M, Mukerjee S N. Involvement of mastoid in secretory otitis media:a radiological and operative study. Ind J Otol (Mar.) 1998;4(1):50-52.

63. Takasaka T, Dawamoto K._ Mucociliary dysfunction in experimental otitis media with effusion. Ann Otolaryngol1985;6:232-236.

64. Giebink G S, Ripley M L, Wright P E. Eustachian tube histopathology during experimental influenza A virus infection in chinchilla. Ann OtolRhinoILaryngol 1987;119-206.

65. Zaidi S H. Repeated U.R.T.I. and mastoid pneumatization. Pak J Otol1991;7:17-19.

66. Arora M M L, Sharma V L, Mehra Y N. Mastoid pneumatization in chronic suppurative otitis media and its clinical significance. J LaryngolOtol 1978; 93:395-398.

67. Shea J J, Lindeman P. Size of the mastoid air cell system in children with middle ear effusion .Laryngoscope 1990;90:1840-1844.

68. Stern C. Principles of Human genetics 1973.3 rd ed. W.H. Freeman & co., San Francisco :443-67

69. Graham M, Brackmen D. Acromegaly and the temporal bone .JLaryngolOtol 1978;92:275-279.

70. Rudin R, Svardsudd K, Tibbin G. Otitis media and the mastoid cell system.A study of men born in 1913 and 1923. Acta Otol(Stockh.)1987;103:217- 225.

71. Bluestone. C D,Paraoise L, Beery O C. Physiology of the eustachian tube in pathogenesis & management of middle ear effusions. Laryngoscope 1972;82:1654.

72. Ars B, Ars-piret N. Middle ear pressure balance under normal conditions.

Specific role of middle ear structure .ActaOtolaryngol Belgica 1994;48(4):399-42.

73. Diament M. Otitis and pneumatization of mastoid bone. Acta Otolaryngol Supple.1940;41:10.

74. Flisberg K, Zsigmond M. The size of mastoid air cell system. Acta Otolaryngol1965;66:23-29.

75. Andreasson L. Correlation of tubal function and volume of mastoid and middle ear space as related to otitis media. Ann OtolRhinolLaryngol1976;85:198-203.

76. Arora M M L, Sain U S, Sodhi J S. Mastoid pneumatization in children-A roentgographic planimetric study. Ind J Otol1973;25:87-90.

77. Chatterjee D, Ghosh T B, Ghosh B B. Size variation of mastoid air cell system in Indian people at different age groups:a radiographic planimetric study. J LaryngolOtol 1990(Aug.); 104:603-605.

78. Holmquist J ,Hallen 0. Eustachian tube function and. the mastoid air cell system in tympanoplasty. Otolaryngol Clin N Am 1970(Feb.);3:95-101.

79. Virtanen H ,Paiva T ,Jauhianien T. The prognostic value of eustachian tube function measurements in tympanoplastic surgery. Acta Otolaryngol1980;90:317-323.

80. Holmquist J. Size of mastoid air cell system in relation to healing after myringoplasty and to eustachian tube function. Acta Otolaryngol1970;69:89-93.

ANNEXURE

PROFORMA

- **PATIENT PARTICULARS**

NAME:

AGE/SEX:

OPD NO:

- **HISTORY**

CHIEF COMPLAINTS:

PAST HISTORY:

FAMILY HISTORY OF HEARING LOSS:

- **EXAMINATION**

GENERAL EXAMINATION:

LOCAL EXAMINATION:

EAR- (RIGHT) (LEFT)

EXTERNAL AUDITORY CANAL

TYMPANIC MEMBRANE

TFT

1. RINNE'S-
2. WEBER'S-
3. ABC-

VALSALVA MAN.

NOSE & PNS

THROAT

- **MICROSCOPIC EXAMINATION OF THE EAR:**
- **INVESTIGATIONS**
  HEMOGRAM:
  URINE ROUTINE EXAMINATION:
  PTA:
  X-RAY MASTOID LO VIEW:
  ET FUNCTIONS BY FLOURESCEIN DYE METHOD:
- **FOLLOW UP**
  STATUS OF GRAFT AT 8 WEEKS
  PTA AT 8 WEEKS

DEPARTMENT OF ENT

SANTOSH MEDICAL COLLEGE & HOSPITAL

GHAZIABAD, U.P

You are being requested to take part in a study entitled"Effect of Intranasal Steroids on Naso Mucociliary Clearance on Allergic Rhinitis"VOLUNTARY PARTICIPATIONYour participation in the study is entirely voluntary and you are free to withdrawFrom the study as and when you feel so.

CONSENT FORM

I, _____ Son/ Daughter/ Wife of _____ Resident of

_____ Hereby declare that I give my

Full, free and voluntary informed consent in the thesis

"Effect of Intranasal Steroids on Nasal Mucociliary Clearance on Allergic Rhinitis"

Dr._____ has informed me to my full satisfaction, in the language I

Understand, about the purpose, nature of study and various laboratory investigations for

The study is to be carried out. I have been informed about the duration of the study and

Instructions to be followed during the study period.

I give full consent for being enrolled in the above study and I reserve my rights to

Withdraw from this study, whenever I wish without prejudice of my right to undergo

Further treatment at Santosh Hospital, Ghaziabad, U.P.

Patient's/ Patient's relative's signature Doctors signature

Or thumb impression

Name: Date:

We have witnessed that the patient signed the above form in the presence of his free

Will after fully understanding its content.

1. Signature of witness

Name:

2. Signature of investigator

Name:

Dr. Samridhi Mishra
Post Graduate Student
Batch: 2020-2023
Department of ENT
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P)
Phone no. 8130050758

संतोष मेडिकल कॉलेज एवं अस्पताल (गाजियाबाद)

सूचितसहमति

ASSESMENT OF EFFECTS OF EUSTACHIAN TUBE FUNCTION AND MASTOID PNEUMATIZATION ON THE OUTCOMES OF MYRINGOPLASTY

मैं _____बेटा/ बेटी_____

निवासी_____ घोषणा करता हूं

कि, डॉ._____, ने मुझे मेरी भाषा में अपने अध्ययन,

अध्ययन के उद्देश्य के बारे मे, और अध्ययन के दौरान अपना ईजानेवाली विभिन्न प्रयोगशाला जांच के बारे में सूचित कर दिया है। मुझे अध्ययन की अवधि और उसके दौरान अपना एजाने वाले निर्देश भी मेरी भाषा मे समझा दिए गए हैं| मैं उपरोक्त अध्ययन में बिना किसी दबाव के दाखिला ले रहा हूं और पूर्ण सहमति दे रहा हूं| सन्तोष अस्पताल, गाजियाबाद में अपने आगेके उपचार पर बिना प्रतिकूल प्रभाव डाले इस अध्ययन से और प्रयोगशाला जांच कीप्रकृति से मैं जब चाहूँ बाहर जाने के अपने अधिकार को सुरक्षित रख रहा हूं|

गवाह के हस्ताक्षर

रोगी के रिश्तेदार के हस्ताक्षर:
या अंगूठे का निशान
नाम
दिनांक:

Signature of Investigator
Dr. SAMRIDHI MISHRA
Post Graduate Student
Batch: 2020-2023 Department of ENT
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P.)

Phone no.8130050758

KEY TO MASTER CHART

ABC-ABSOLUTE BONE CONDUCTION

ET-EUSTACHIAN TUBE

L.C.-LARGE CENTRAL

NAO-NO ABNORMALITY DETECTED

PERF^{N}-PERFORATION

POLYP-POLYPOIDAL

S.C.-SMALL CENTRAL

S.T.-SUBTOTAL

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

F. No. SU/2021/1830[69] Dated: 17.07.2021

Subject: Grant of Ethical Clearance for Thesis Protocol Topic **"ASSESSMENT OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID PNEUMATISATION ON THE OUTCOMES OF MYRINGOPLASTY"**, submitted by **Dr. Samridhi Mishra,** MD/MS student of Batch 2020-2021, Department of **ENT**.

*****

With reference to his/her request for grant of Ethical Clearance for the Thesis Protocol entitled **"ASSESSMENT OF THE EFFECT OF EUSTACHIAN TUBE FUNCTION AND MASTOID PNEUMATISATION ON THE OUTCOMES OF MYRINGOPLASTY"**, **Dr. Samridhi Mishra** is informed that the Thesis Protocol submitted by him/her was considered by the **Screening Committee** of the Santosh Medical College & Hospital in its meetings held on 19.03.2021, 22.03.2021, 24.03.2021, 25.03.2021, 26.03.2021, 27.03.2021 and 06.04.2021. The recommendations of the **Screening Committee** were considered in detail by the Institutional **Ethics Committee** in its meeting held on **12.07.2021** and the same was **approved** by the **Ethics Committee**.

He /She is informed accordingly for further necessary action.

[Dr. V. P. Gupta]
REGISTRAR

Dr. Samridhi Mishra
MD/MS student of batch 2020-2021
Department of ENT
Email: mishrasamridhi332@gmail.com

Copy to:

1. The Vice Chancellor
2. The Dean, SMC&H
3. The Dean – Research
4. The Dean – Academics
5. The Director - IQAC
6. Dr. Vandana Singh (Guide)
7. HOD of **ENT**

Ouriginal

Document Information

Analyzed document	Dr Sam thesis.docx (D149444717)
Submitted	2022-11-12 08:41:00
Submitted by	Dr Jyoti Batra
Submitter email	drjyotibatra89@gmail.com
Similarity	0%
Analysis address	drjyotibatra89.sug@analysis.urkund.com

Sources included in the report

W	URL: http://www.idahoear.com/condition-eustachian-tube-problems.html Fetched: 2020-12-10 20:21:25	1
W	URL: https://core.ac.uk/download/pdf/235670153.pdf Fetched: 2022-01-26 09:05:08	2

Entire Document

INTRODUCTION

Myringoplasty is among the most commonly performed surgical procedures by ENT surgeons worldwide, involving the reconstruction of tympanic membrane perforations, with an appropriate graft material, such as autograft, allograft, or synthetic materials. There has been continuous advancement in the approach and technique of performing a procedure, but the incidence of unfavorable outcomes has still been significant. The functional status of the Eustachian tube and mastoid cell pneumatization is among the most significant prognostic factors of myringoplasty. Studies based on the prognostic value of Eustachian tube function on the outcome of myringoplasty have not been conclusive due to contradictory inferences. Not much literal evidence is available on the postoperative hearing status of the patient, as an assessment criterion. This study involves the evaluation of the combined effect of eustachian tube function and mastoid cell pneumatization on the results of myringoplasty in terms of graft uptake and hearing improvement, the study also involves the assessment of co-relation between Eustachian tube function and mastoid air cells pneumatization. The study is being formulated on the principles of interventional study, which involves case selection based on pre-determined criteria, pre-op evaluation of the cases, surgical procedures, and follow-up.

ANATOMY The tympanic membrane is an oval structure present between the EAC and the tympanic cavity, it lies obliquely at the end of the EAC. It is convex towards the middle ear cavity and the umbo is known as the point of maximum convexity. The dimensions of the tympanic membrane are the following in adults. Length-10 mm approx Width-9 mm approx Thickness-around 0.1-0.2 approx It consists of three layers 1) Outer epithelial layer, (continuous with epithelial of EAC) 2) Middle fibrous layer. (present only in pars tensa) 3) Inner mucosal layer. The handle of the malleus has adhered to a fibrous layer with its short process projecting laterally. The annulus is the fibro-cartilaginous ring that fits into the tympanic sulcus of temporal bone; it is the incomplete ring that is deficient above forming the notch of rivinus, which is occupied by the pars flaccida. VASCULAR SUPPLY • External supply by Arteria Manubri, which is a branch of the deep auricular branch of the maxillary artery.

• Internal supply by;

a) Peripheral vascular circle including

- Anterior tympanic artery.
- Posterior tympanic artery.
- Tubal twing from ascending pharyngeal anastomosis.